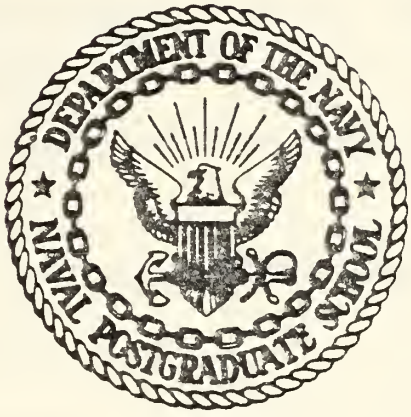
1977-03

An interactive computer interface with a digital receiver

Borries, William Glenn

Monterey, California. Naval Postgraduate School

NAVAL POSTGRADUATE SCHOOL
Monterey, California



THESIS

AN INTERACTIVE COMPUTER INTERFACE
WITH A DIGITAL RECEIVER

by

William Glenn Borries

March 1977

Thesis Advisor: S. Jauregui

Approved for public release; distribution unlimited.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)
An Interactive Computer Interface with a Digital Receiver

5. TYPE OF REPORT & PERIOD COVERED
Master's Thesis
March 1977

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)
William Glenn Borries

8. CONTRACT OR GRANT NUMBER(s)

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Naval Postgraduate School
Monterey, California 93940

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS
Naval Postgraduate School
Monterey, California 93940

12. REPORT DATE
March 1977

13. NUMBER OF PAGES
124

14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)
Naval Postgraduate School
Monterey, California 93940

15. SECURITY CLASS. (of this report)
UNCLASSIFIED

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)
Approved for Public Release: Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)
Register
Buffer
Interface
Digital
Computer

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
A computer interface to connect both the Applied Technology Airborne Computer (ATAC) and the KIM-1 Microprocessor to a Watkins Johnson digitally tuned receiver was designed and constructed. The existing ATAC computer program was modified.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 68 IS OBSOLETE
S/N 0102-014-6601

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Approved for public release; distribution unlimited

An Interactive Computer Interface with a Digital Receiver

by

William Glenn Borries
Lieutenant, United States Navy
B.S., United States Naval Academy, 1970

Submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN ELECTRICAL ENGINEERING

from the

NAVAL POSTGRADUATE SCHOOL
March, 1977

ABSTRACT

A computer interface to connect both the Applied Technology Airborne Computer (ATAC) and the KIM-1 Microprocessor to a Watkins Johnson digitally tuned receiver was designed and constructed. The existing ATAC computer program was modified.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

A/D	Analog to Digital
ASCII	American Standard Code for Information Interchange
Baud	Bits per second
D/A	Digital to Analog
high	TTL logic 1 (+5v)
I/O	Input and/or Output
IC	Integrated Circuit
IF	Intermediate Frequency
ISB	Intermediate Sideband
low	TTL logic 0 (0v)
LSB	Lower Sideband
TTL	Transistor Transistor Logic
USB	Upper Sideband
BFO	Beat Frequency Oscillator

ACKNOWLEDGEMENTS

I would like to express my deep appreciation to Carole Hickey who wrote the initial ATAC programs. Without her Main System the programming that I did would have been unbearable. I would also like to thank the following people who have helped along the way: LT. Al May, Al Gilkes, Greg Ramos, LT. Bill Hickey, Bob Glaz, Dave Blonden, Dean Hayes, and Virginia Ward. Most importantly, I want to thank my wife, Cathy, for all the encouragement and advice she has given me during the writing of this thesis.

I. INTRODUCTION

For many decades man has dreamed of the day when machines could relieve him of much of his work. In this era of computers and advanced technology, this dream is now becoming a reality. Connecting computers to other machines, however, is not just a simple matter of running a wire from one to the other. In order for the computer to be able to use its "thinking" ability, it must have some way to translate its signals into a form that is recognized by the machine it is controlling. This is where the interface becomes all important.

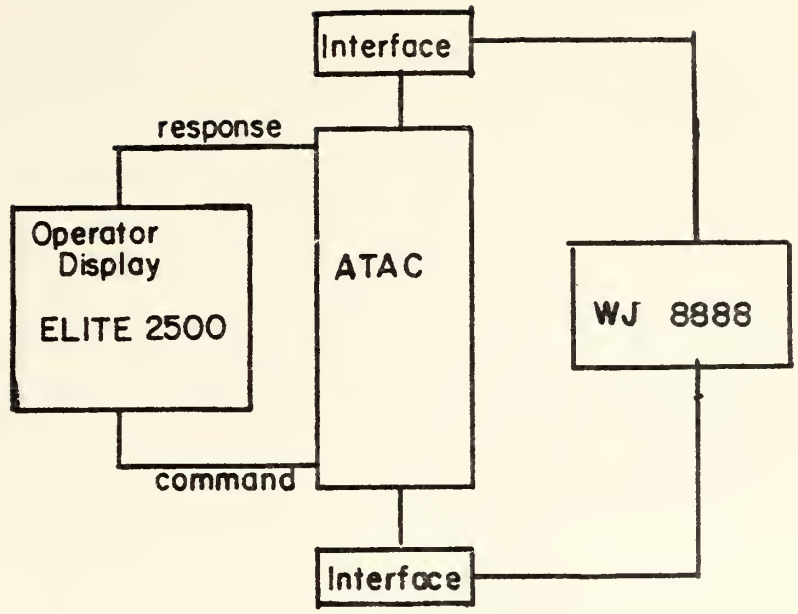
An interface is a piece of equipment placed in the data path between two devices. Its purpose is to rearrange, translate, or change the speed of this data to meet the needs of one or both devices. In other cases the interface is used to convert data from an analog to digital (A/D) or digital to analog (D/A) form, or both. Interfaces of either type range in complexity from a few integrated circuits to the use of microprocessors. Most, however, fall in between. This thesis discusses the design and construction of an interface in this middle class. Here, the computers are the Applied Technology Airborne Computer (ATAC) minicomputer and the MOS Technology Inc.'s KIM-1 microprocessor. Their goal is to program and process outputs from a digitally tunable Watkins Johnson WJ-8888.

The two computer systems arrive at their goal by

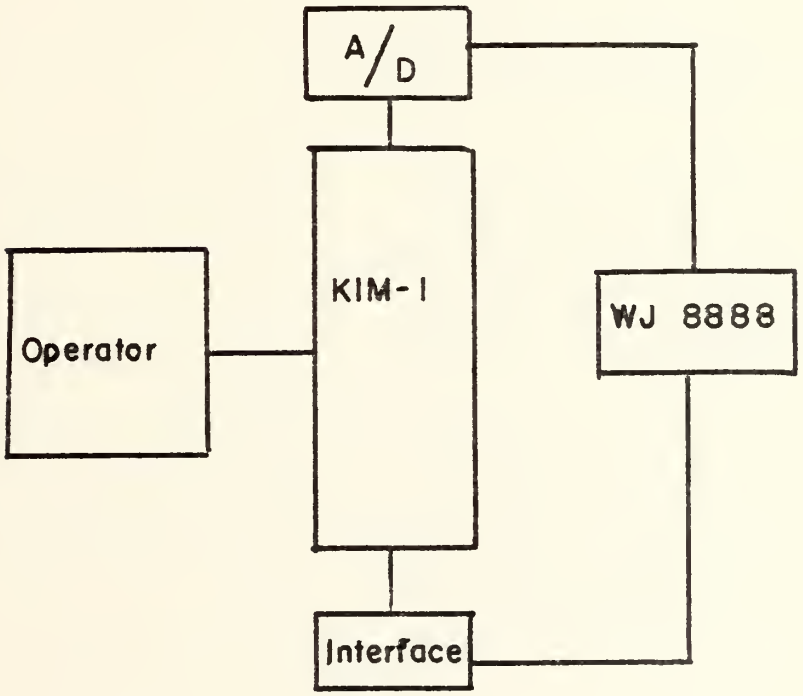
different means. The ATAC uses a closed loop with the operator (Figure 1a) while the KIM-1 excludes the operator while executing its program (Figure 1b). In the ATAC loop the operator actively controls all communication between the computer and receiver. In this way it is possible to display information from the receiver on the video display at any time except during a scan (see Chapter V). It also provides quick reference to the data to be sent, the data last sent, and latest received data. This was invaluable during debugging. From the terminal it is also possible to adjust available parameters as necessary to meet any requirement.

The KIM-1 does not directly exchange digital words with the receiver, but rather exchanges digital data for analog data. This does not provide a feedback loop that includes the operator. Once begun, the KIM-1 program selects and sends data words to the receiver and processes the analog data received until the program comes to an end or is halted by the operator. Direct information is not available to determine when or if a digital word has been sent or received correctly.

Problems encountered during the design and construction of the interface and their solutions are shown in Table I. In this instance signal level compatability was not a problem because the I/O from the receiver, the interface, and the two computers were all TTL logic levels and, therefore, matched. It is believed that these problems are a typical list that may be encountered when interfacing.



(a)



(b)

Figure 1
Computer Control

PROBLEM	SOLUTION
1. Noise on the ATAC I/O lines.	1. Use of Schottky circuits reduced or eliminated the noise.
2. Different clock rates of the computers and the receiver, and different data word lengths.	2. ATAC; converted parallel outputs into serial form. KIM-1; used interrupt lines to slave the KIM-1 to the receiver's clock.
3. Timing	3. Identified receiver periods by the Monitor Clock output. This provided a pulse which signaled stable data.
4. Inputting data to the ATAC.	4. Open collector buffers were used to sink the required current for proper data transfer.
5. Switching between the ATAC and the KIM-1.	5. Multiplexers and buffers were used to switch between the two computers.

Table I

Problems and Solutions

II. THE RECEIVER

The Watkins Johnson WJ-8888 (WJ) is an HF receiver designed for use in the 550 KHz to 30 MHz band. Its advantages include the ability to detect and output both the AM and FM IF signals while simultaneously maintaining a separate output of eight selectable detection modes. Options available to the operator include different IF bandwidths, variable RF gain, squelch control, and a tuneable BFO frequency. The WJ is digitally controlled and uses a 64-bit word as shown in Figure 2. This word contains the information necessary to transfer the frequency, detection mode, IF bandwith, RF gain, BFO frequency, and signal strength both internally and externally.

All inputs and outputs from the receiver are controlled by the synchronous, remote I/O board. This board is a gated transfer point for all digital data exchanged with the receiver. A number of control lines are needed to provide the necessary demands on the receiver. Three balanced input pairs and four balanced output line pairs, plus a ground are provided for this purpose. All three inputs are required for remote operation. They are address (or enable), trigger, and data input. The address pair is the most important for it serves as the master "on-off" switch for the remainder of the I/O pairs. The outputs furnish the required clocks (command and monitor), output data, and a local/remote status.

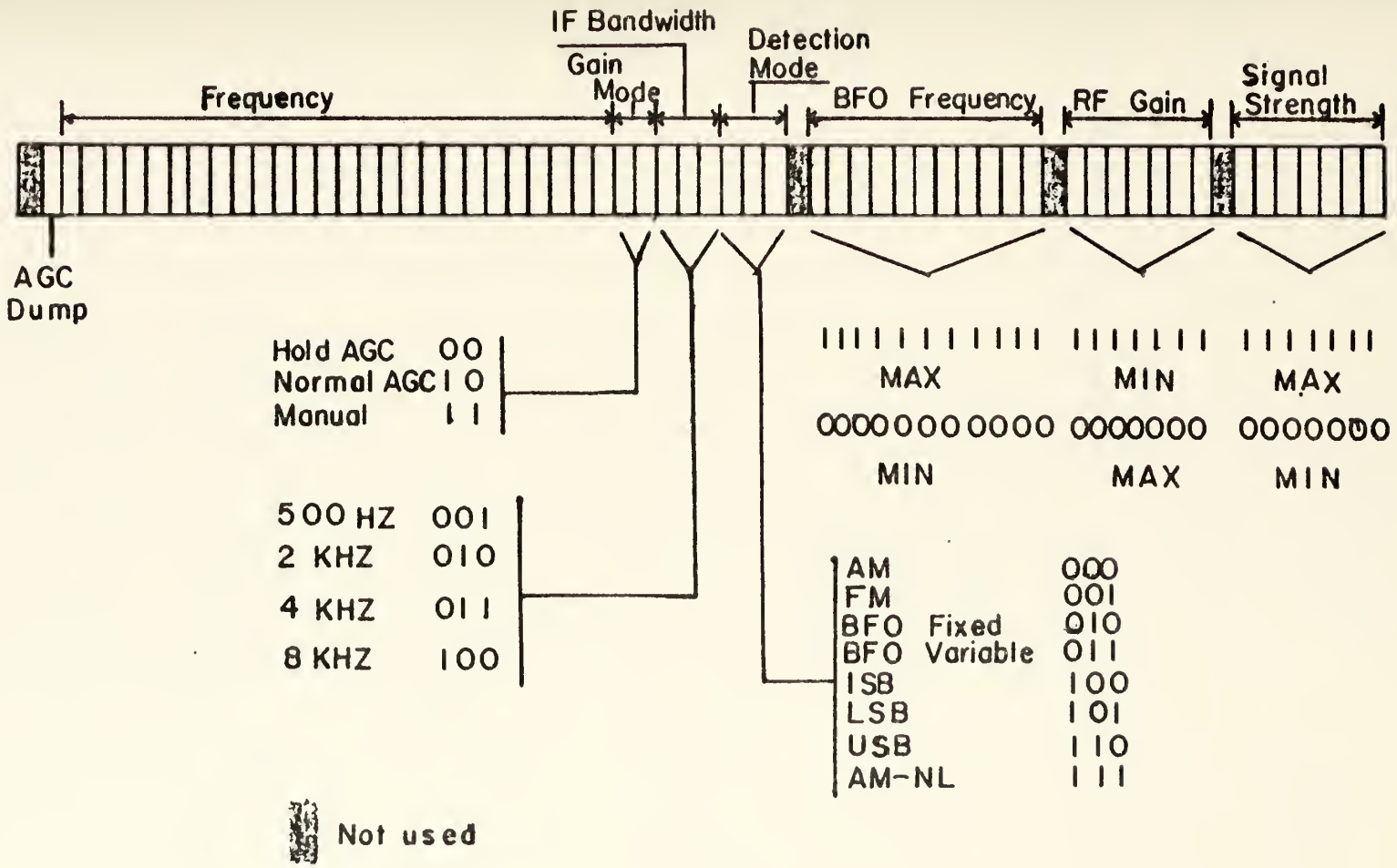


Figure 2

Receiver's Word

The Watkins Johnson operates on a sequential cycle divided into four equal periods and six identifiable modes. The periods regulate the different operations while the modes ascertain the origin of the data. Table II shows the interaction of the periods and modes of the receiver. Three of the six modes are memory read and write functions; these cannot be remotely controlled and, therefore, are of no concern here. Of the remaining three, two are the remote active and remote passive modes. These allow the introduction of externally generated data and prevent manual intervention during all but one of the four periods. Manual control is available in the remaining mode, local.

In order to manage the data word movement correctly, the receiver utilizes a common bus or data node arrangement as shown in Figure 3. This simplifies operation by forcing all data words to pass through this node in the same direction, regardless of their origin or desired destination. The multiplexer controls the input to the data node. Control of the multiplexer and, therefore, the origin of the data is managed by the internal modes of the receiver. The objective of period one is to load the receiver register. In the local and remote passive modes, the data word is shifted from the front panel register, through the multiplexer and data node, into the receiver register. The difference between these two modes is in the action of the data prior to shifting. The local mode updates the data word from the front panel storage registers during the early

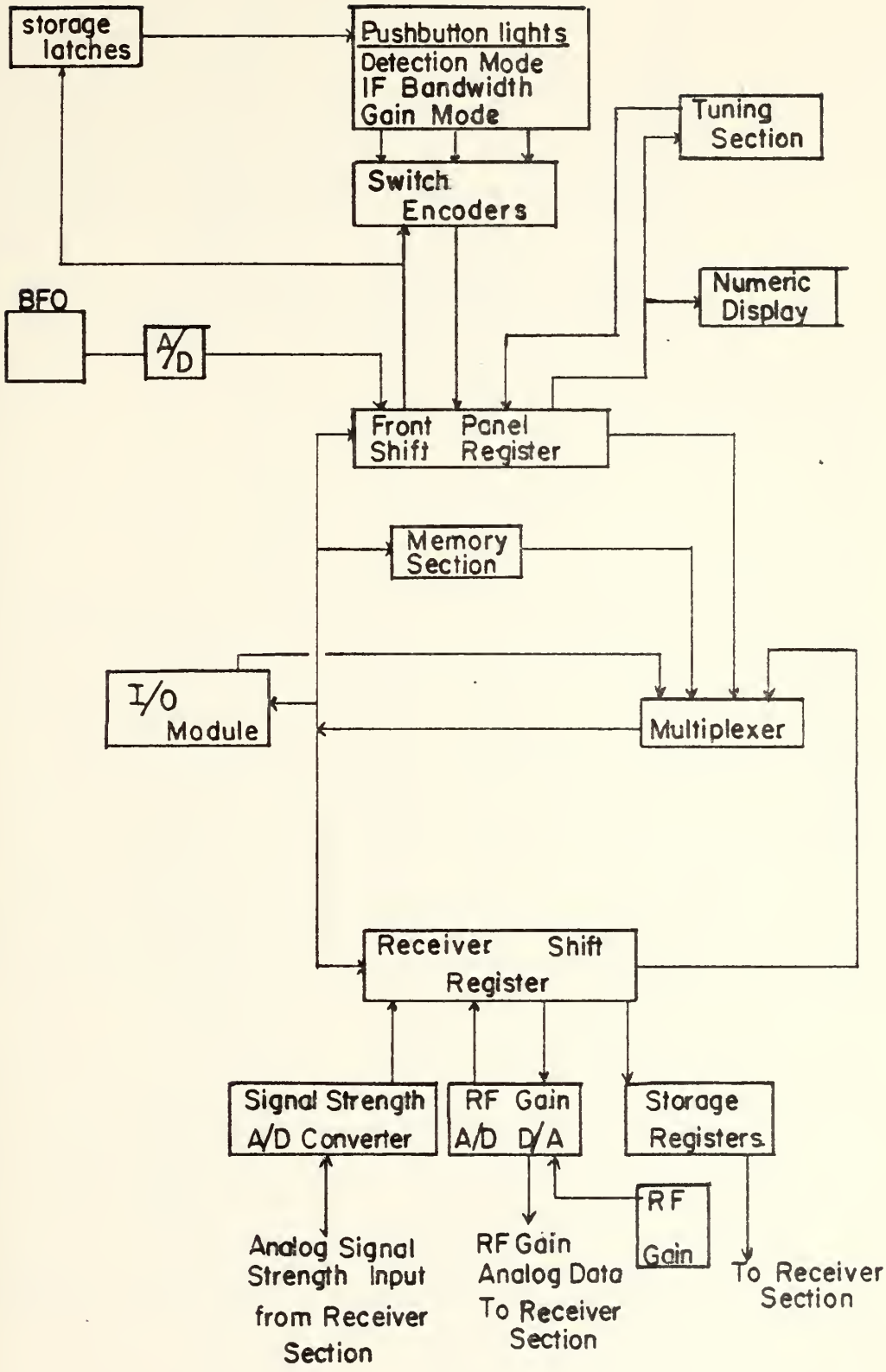


Figure 3
Block Diagram of the Digital Section

	Period 1	2	3	4
Local	Load Front Panel Reg from Front Panel/word shifted to Receiver Register	Load Rcvr Storage Reg/ Signl Strength and RF gain updated /word shifted to FrontPanel Register	Display updated no words shifted	Change to Remote Active or Remote Passive possible
Remote Passive	Word shifted from FrontPanel Register to Receiver	Update only Sig Str /Load Rcvr Storage Reg/word shifted to FrontPanel Reg.	Same as Local	Change to Lcl or Remote Active possible
Remote Active	Word shifted from I/O module to Receiver Register	Same as Remote Passive	Same as Local	Change to Remote Passive automatic. Change to Local possible

Table II

Receiver Modes and Periods

portion of period one. This action is inhibited during the remote passive mode. In the remote active mode the data word originates from a remote device, is shifted by the command clock through the remote I/O board, on to the receiver register via the multiplexer and data node.

The first part of the second period is spent loading the data shifted during period one into the receiver storage registers. During this time the signal strength is updated in the receiver register regardless of the mode. The RF gain A/D-D/A converter functions according to the selected mode. In the local mode the RF gain bits in the data word are replaced by A/D conversion of the front panel RF gain control knob. The two remote modes reverse this action and load the RF gain D/A converter with this data from the word. After this is completed, the word is shifted in all modes out of the receiver register, through the multiplexer and data node, and into the front panel register. If the address line from the remote device is active high, the data word and the monitor clock are available on their respective output line pairs.

Periods three and four inhibit movement of the data word. Period three updates the front panel pushbutton lights and numeric display. Period four is the only period in which changes in receiver mode are allowed. During this period changes from a remote mode to local, or from local directly to remote passive can only be accomplished by depressing the appropriate pushbutton on the front panel. A

change from local and remote passive to remote active is automatically done by the remote I/O board whenever both the address and trigger line pairs are active high during this period. The remote active mode immediately reverts to the remote passive mode at the beginning of the next period four. The total cycle time of the receiver is 10.24 msec (2.56 msec per period). In order to change modes successfully, it may be necessary either to hold in the pushbutton or to hold the trigger and address lines high for up to 7.68 msec (three periods). This ensures that the mode change demand occurs in period four.

All outputs are available from connectors J1, and J6 through J10 located on the back of the receiver. J1 is the digital I/O connector. The other connectors are all analog outputs. J6 is a 455 KHz IF signal of at least 20 KHz bandwidth. AM and FM detector monitors are provided at connectors J7 and J9 respectively. J8 is a predetection, 455 KHz center frequency IF output whose bandwidth is set by the front panel. A balanced and unbalanced line audio and both upper and lower sideband outputs are available from the appropriate pins at J10. The balanced line operates at all times. The unbalanced line is operable unless headphones are plugged into the front panel. The lower sideband output is active when the receiver is in either ISB or LSB detection modes, and the upper sideband output is active during ISB, USB, and CW modes.

III. THE COMPUTERS

After studying the inputs and outputs from the receiver, three choices were available for further development of the interface. It could be designed to pass the clock pulses on to the interrupt lines of the computer and, therefore, match the computer's timing to that of the receiver. Or, a buffer could be constructed to input the data serially at the clock rate of the computer and output it at the clock rate of the receiver. The third choice, also a buffering arrangement, could exchange data in parallel to the computer and serially to the receiver.

The chief factor influencing the design decision was the availability and distribution of computer control and I/O lines. For the first computer, the primary objective was to investigate the feasibility of both remotely tuning the receiver and accepting a data word in return. The requirements for the second computer, the MOS Technology Inc. KIM-1, were less strict. Its objective was to tune the receiver digitally through use of the interface. Its input, however, was to come from a A/D converter for processing.

A. THE ATAC

The ATAC was originally designed to provide EW service to aircraft. Built to do real-time analysis of signals, it has very short cycle times, optional microcode programming, and double precision arithmetic as part of the standard package. All this, combined with its large instruction set, makes the ATAC a versatile and powerful tool. Although data could be transferred serially by proper programming, the ability of the ATAC to both input and output sixteen bits in parallel on the PIO (parallel input/output) lines proved more advantageous. Any one of the ATAC's sixteen registers can input or output from these lines. In order to properly transfer this data, the PIO bus must be augmented by an address provided by the sixteen bits of the "extended" Arithmetic Register (XAR). Another necessary output is one that informs the external device when the ATAC is ready for the transfer. On the ATAC this function is provided by the Input/Output Demand (IOD) line. Referring to the timing diagram in Figure 4, an input command is initiated by placing an address on the XAR lines and following this address with a low on the IOD. This signifys that the ATAC register is ready for data. After approximately one microsecond, the IOD is placed high and the address is removed. During this microsecond the data for the ATAC must be stable. For an output command, the XAR and the PIO lines first present the address and data for output. When they

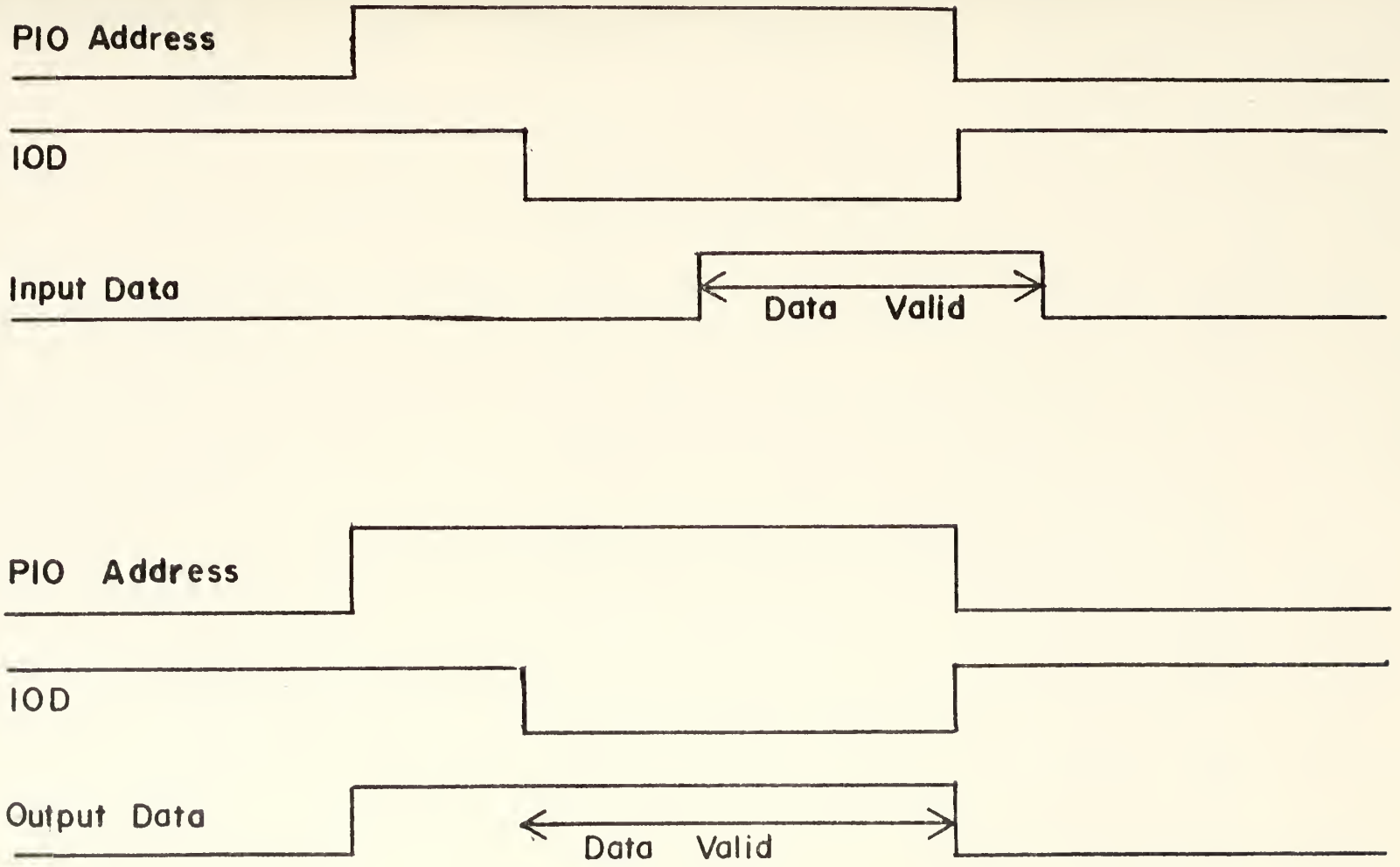


Figure 4
ATAC I/O Timing Diagram

are stable, the IOD line is set low. The data is then available for about a microsecond, as before. The IOD line is then placed high and the address and data are removed from their respective lines.

For operator interaction a serial ASCII, RS232 I/O port is also available. A Datamedia Elite 2500 television terminal is connected here to provide the operator with the necessary control and programming capablity for use of the ATAC. By proper programming and use of the XAR lines, it was possible to translate each command for the interface. Using a demultiplexer on the interface board, four of the five available XAR addresses were separated into sixteen separate commands. One of the remaining lines and the IOD line were used as strobes to identify the receiver and to signify stable data (Chapter III). This arrangement provided both the adequate isolation and flexible operation desired.

B. THE KIM-1

The KIM-1 is at the other end of the computer spectrum with respect to the ATAC. It is a microprocessor designed around the MOS Technology Inc. series MCS6500 Central Processor Unit. Complete on a single printed circuit board, the KIM-1 is simple to operate and easy to program. While its cycle time is slower than that of the ATAC, it is still much faster than the receiver and more than adequate to meet

the requirements. Since the input data came from converted analog data supplied from the receiver's FM IF output (J9) and an external A/D converter, the design for this portion of the interface was simpler.[1]

---

[1]For a more detailed discussion of the KIM-1, its objectives, programs, and operating procedures, see Signal Acquisition and Sampling Using a Microprocessor, by LT. D. Rosenberger.

IV. THE INTERFACE

The interface was initially designed solely for the ATAC. A means of converting four ATAC words into one receiver word was needed first, in order to test the program, the computer, and the receiver together. The simplest and cheapest way to accomplish this conversion and still fully utilize the capabilities of the ATAC was to build a 64-bit register using eight parallel-in, serial-out, eight-bit shift registers. A control section was also necessary to properly handle this data. The ATAC XAR addresses were decoded by this control section to provide the load commands for the registers and to signal the receiver to input the word.

The next step in construction was also simple in theory. Since the computer uses the PIO lines for input as well as output, what was needed was a connection which would not interfer with the section already built. The ICs chosen to isolate the two sections are called Tri-State. These ICs have a "no output" state in addition to the normal high and low of TTL circuits. They could not, however, sink or supply enough current to drive the computer PIO bus. A solution was found by following these ICs with open collector buffers. Not only did they provide the necessary amplification, they did not degrade the isolation performance of the Tri-States. This second section also had

a 64-bit register built from the smaller shift registers. In this case, though, they were serial-in, parallel-out. In order to remove the word from the register in sixteen-bit sections, the outputs from the shift registers were connected to four-to-one multiplexers. These multiplexers were Tri-State. With the proper control it was possible to shift the word from the receiver into this register, and transfer it to the PIO bus in the correct sequence.

Increased complexity in the control section came with this implementation. A method was needed to prevent the computer from transferring a word until it had been completely shifted into the register. The period two clock output from the receiver was used as a reference to provide a pulse to inform the computer when shifting was complete. This pulse was positioned in the same time interval as period three of the receiver. The additional benefit of identifying period four was obtained. This meant that the output for the trigger line to the receiver could be shorter and still meet the requirement to occur in a portion of period four.

After completion of the testing for the ATAC, an interface was designed and constructed for the KIM-1. This design was very simple to implement, since all the necessary timing circuits were already built and tested. The two computers were kept from interferring with each other by installation of a manual switch. This switch controls the

address of a multiplexer that separates the lines in the interface common to both computers. The control section was wire-wrapped rather than placed on a printed circuit board to provide greater flexibility, easier maintenance, and to reduce cost.

A. THE CONTROL SECTION

The heart of the interface is the control section (Figures 5 and 6). The main purpose of this section is to decode and route commands from the ATAC and provide the necessary circuits to interface with the receiver. It also contains the circuits for the operation of the receiver by the KIM-1. The receiver's outputs are driven by line drivers which provide complementary TTL levels. The inputs are applied to line receivers which accept these complementary TTL levels. The interface, therefore, had to use these same receivers and drivers to be compatable with the Watkins Johnson.

The SPST switch mounted on the front of the interface case selects the computer controlling the receiver. With the switch in the ATAC position, a high is placed on pin 1 of IC-JJ and pins 1 and 10 of IC-MM. IC-JJ is now set up to transfer the following: the address and data outputs to the line drivers on IC-LL, the trigger command to pin 2 of IC-Z, and a low in line CCK7. The CCK7 line completes the

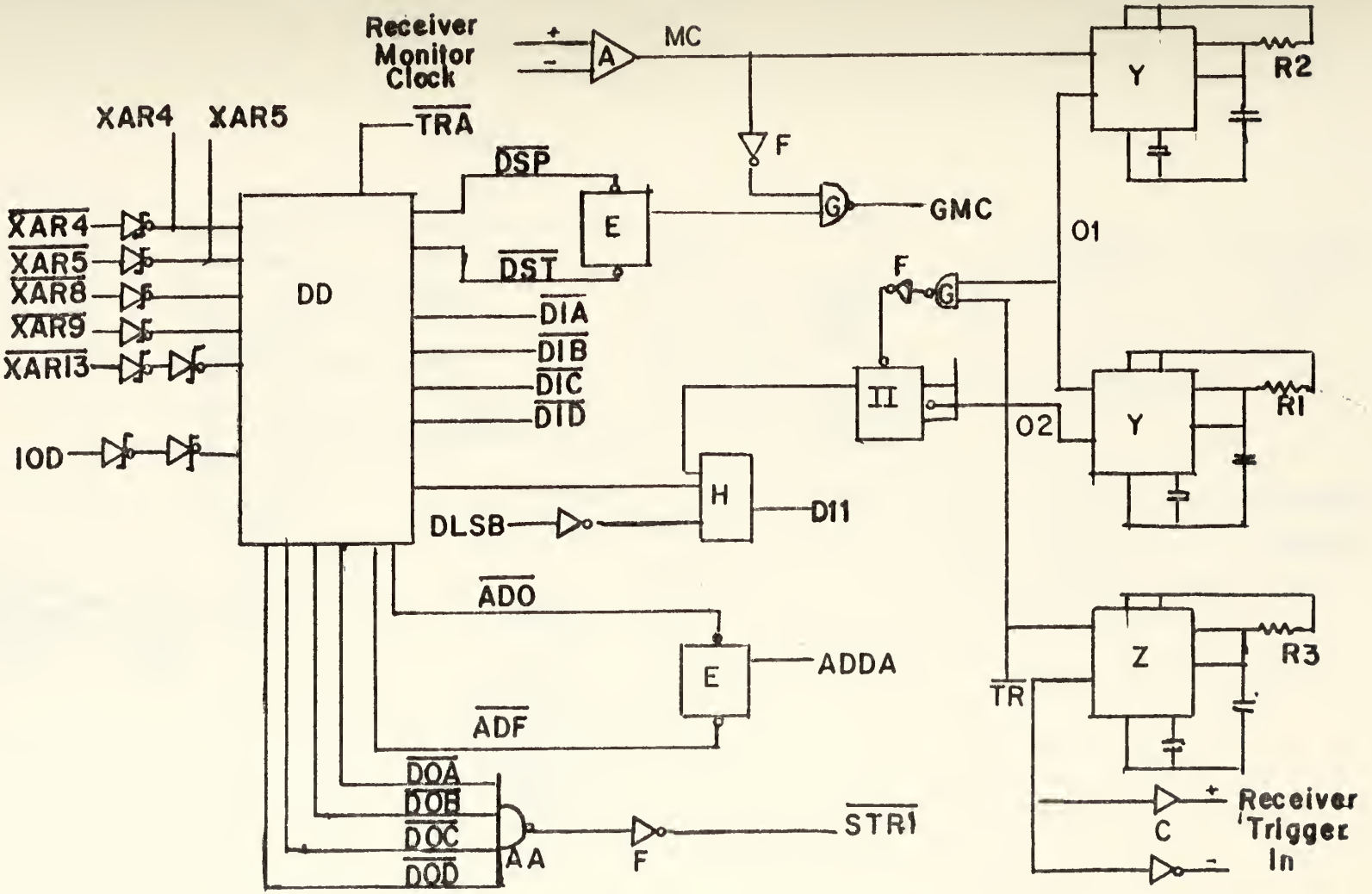


Figure 5
Interface Control Section (Part I)

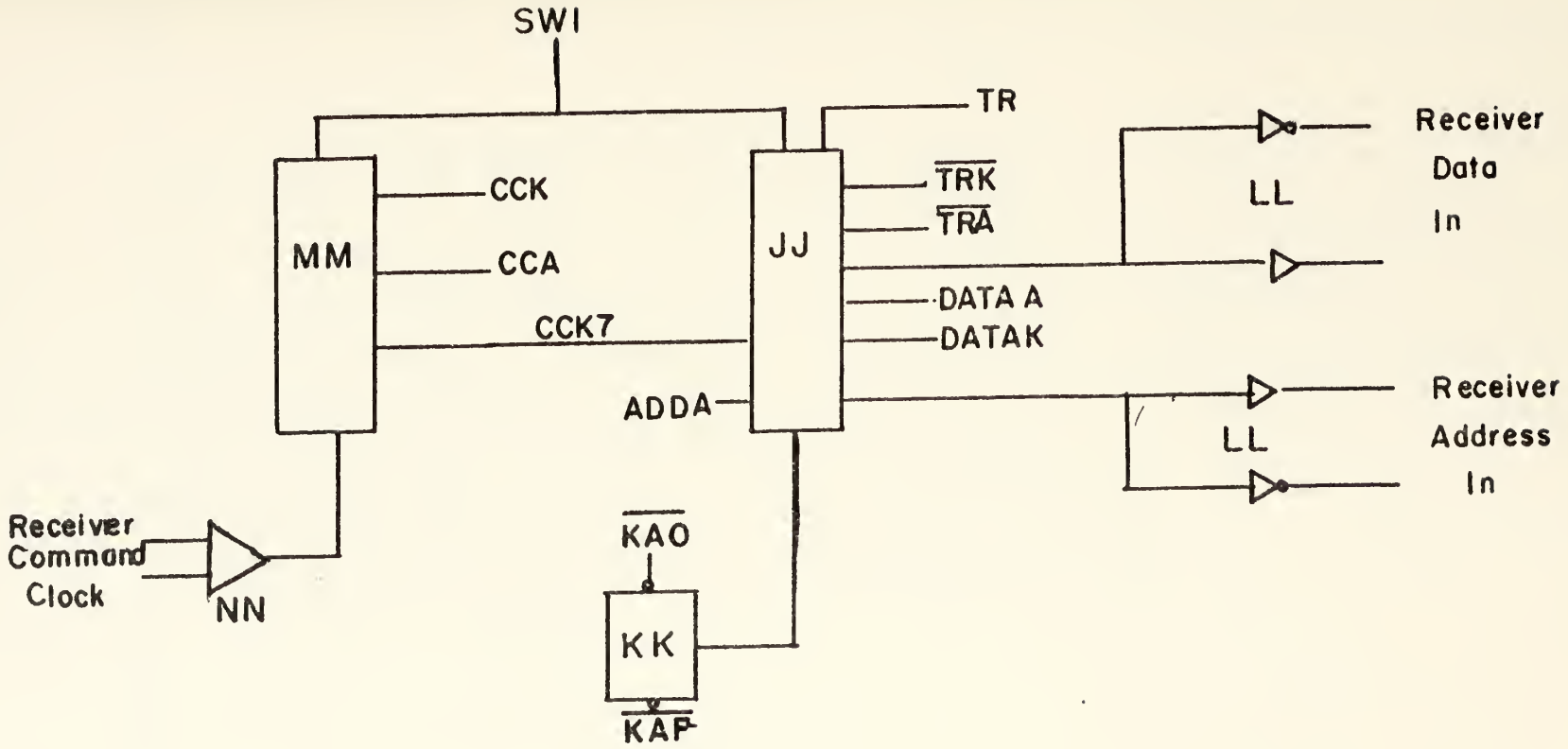


Figure 6
Interface Control Section (Part 2)

TRA	[0]	ATAC Trigger Command
DIA	[1]	Receiver input word one
DIB	[2]	Receiver input word two
DIC	[3]	Receiver input word three
DID	[4]	Receiver input word four
DSP	[5]	Stop Monitor Clock
DST	[6]	Start Monitor Clock
ADO	[7]	ATAC - Address on
DOA	[8]	Receiver output word one
DOB	[9]	Receiver output word two
DOB	[9]	Receiver output word two
DOC	[10]	Receiver output word three
DOD	[11]	Receiver output word four
RDY	[12]	Read bit for ready signal
ADF	[15]	ATAC - Address off
TR		Receiver trigger
CCK		Kim-1 Command Clock
CCK7		Control Line for Kim-1 Command Clock
CCA		Command Clock for ATAC interface
ADDA		ATAC - Receiver Address
KADD		KIM-1 - Receiver Address
KAO		KIM-1 - Receiver Address On
KAF		KIM-1 - Receiver Address Off
TRK		KIM-1 Trigger Command

(Numbers in brackets refer to ATAC XAR commands)

Table III

Interface Command List

commands to IC-MM. This IC is a quad Tri-State buffer which is used to control the destination of the command clock. The switch opens buffer one which directs the command clock to the ATAC. The CCK7 line closes buffers two and four disabling the command clock input to the KIM-1.

The ATAC supplies the control section with six lines. Five of these are the XAR bits 4,5,8,9, and 13. Using 4, 5, 8, and 9 as address lines to pins 20-23 of IC-DD, a four-to-sixteen demultiplexer, sixteen (2^4) unique commands (Table III) were made available. The sixth line, the IOD, and XAR 13 were used as strobes or enables for the demultiplexer. In this way XAR 13 was able to specify this receiver uniquely, and the IOD ensured that addresses and data were stable before passing a command. When both IOD and XAR 13 are low, IC-DD is operational and the output corresponding to the address on pins 20-23 is forced low. At any time that either or both the two strobe lines are high, all outputs of IC-DD are held high and no commands are generated, regardless of the activity on pins 20-23.

At the beginning of the Receiver Control program (Chapter IV), the ATAC sends commands to address the receiver (ADD) and to open the gate for the monitor clock (DST). ADD places a low on pin 2 of IC-E, setting the flip-flop and forcing the ADDA line high. This line activates the receiver's I/O through ICs -JJ, -A, -B, -C, and -LL, as described above. The DST command is passed to

pin 7 of IC-E. This sets this flip-flop and allows the monitor clock (MC) to shift data from the receiver into the storage register during every period two of the receiver's cycle. The MC line is also connected directly to a timing circuit. This circuit produces the pulse described in the early part of this chapter. The first of a pair of monostable multivibrators, IC-Y (Figure 5) is triggered by the first clock pulse of MC. IC-Y outputs a pulse, interval A of timing diagram (Figure 7), which triggers the second. The second's output, interval B, is connected to pin 1 of IC-II, a negative-edge triggered, J-K flip-flop. This IC is wired so that it is set on the output of the second multivibrator and reset by either the the output of the first multivibrator or the command TR. The output of this flip-flop, pin 15, is called the RLP. This line is multiplexed with the least significant bit of the output register and inverted by IC-H for use by the ATAC on line D11.

The RLP pulse is adjustable through variable resistors (trimmers) one and two. Trimmer one controls interval B and trimmer two interval A. In effect, trimmer two varies the position of the pulse and trimmer one its width. The placement and width are the key to proper operation of the interface. The pulse must remain in period three. Although some overlap into period four is allowable it is not desirable, and any overlap into period two could cause

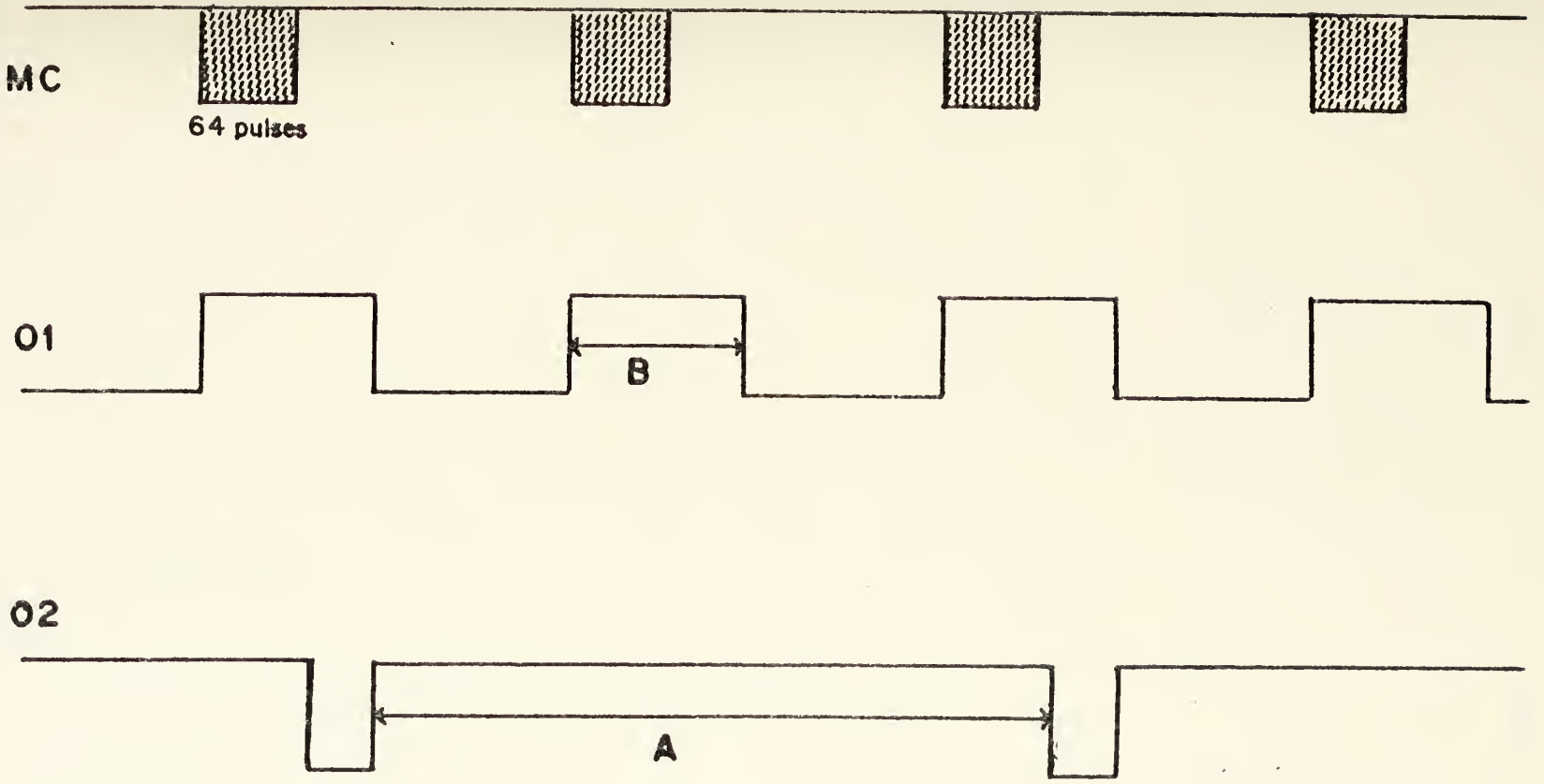


Figure 7
Interface Timing Diagram

incorrect operation. At present, the RLP pulse is programmed for every other period three. This allows the receiver to stabilize between samples taken by the computer. If more or less time is desired, the pulse can be set in every, every other, or every third period three by varying trimmer one. Greater time between pulses can be achieved by changing the .47 uF capacitor (hH-7,8) to one of larger value.

When the ATAC is ready to send a word, it loads the input register of the interface using commands DIA, DIB, DIC, DID, and then waits for a high on the D11 line. When RLP is low, D11 is high and the ATAC sends command IRA. This command is routed to a separate monostable multivibrator, IC-Z, by way of multiplexer IC-JJ. The timing circuit provides the trigger pulse in period four which changes the receiver's mode to remote active. It also sets RLP high to prevent any interaction with the ATAC until this cycle of the receiver is complete. During the following period one, the receiver sends the command clock to the input register via ICs -JJ and -MM, and inputs the data word through ICs -IJ and -LL. Meanwhile, the ATAC is waiting for RLP to go low again. When it does, the ATAC closes the MC gate with a DSP command and loads four sixteen-bit words with commands DOA, DOB, DOC, and DOD. Once the receiver word is stored in the ATAC, a DSIA command is sent to open the MC gate. When the operator has finished excution of the Receiver Control program and exits, the ATAC

sends the interface commands ADF and DSP to turn off the address line to the receiver and close the MC gate. The interface is now back in a stand-by status.

In order to set up the interface for operation with the KIM-1, the reset button must be pushed and the computer switch placed in the KIM-1 position. The reset button is unique to KIM-1 interface operation, and is necessary because of the use of the KIM-1's non-maskable interrupt. This interrupt is used to synchronize the KIM-1 with the receiver's command clock. Pressing the reset button places a momentary low on pin 5 of IC-FK, the flip-flop that controls the receiver's address line from the KIM-1. This resets the flip-flop and insures that the command clock output is disabled until required. ICs -JJ and -MM now transfer data from the KIM-1 and not the AIAC. The CCK7 line follows the address line from IC KK and gates the command clock off and on at the proper time. When the KIM-1 is ready to send a word to the receiver, it waits for a low on the RLP line. This line is connected to the maskable interrupt line. This low generates an interrupt and places the KIM-1 in the output program. This routine provides a trigger pulse for the trigger timing circuit and outputs the data synchronously with the command clock. The difference between the AIAC and KIM-1 actions of the interface is due to the position of the switch. The only function the interface serves is to provide reliable and compatible data to the appropriate device, whether it is receiver or

computer.

b. INPUT/OUTPUT REGISTERS

These two registers are used for the ATAC only. The registers were designated input or output by their related function with the receiver. They were constructed to provide the necessary, temporary storage while converting parallel and serial data back and forth. Both registers are connected to the PIO bus, with the major difference being the Tri-State connections of the serial to parallel, or output register.

The input register (Figure 8) was the easier to implement. It consists of eight 4-bit shift registers with parallel input and serial output. The parallel input comes from the ATAC's PIO bus, which is buffered by schottky inverters to reduce noise. The lines are connected to the ICs in such a way as to load words into two adjacent shift registers simultaneously. This is possible because the shift registers will only latch data in when their respective load line is low. By proper connection of the D1A-D1D lines to pin 1 of the ICs, and coordinating the commands with the data, the output register can be completely and correctly filled. The command clock from the receiver is connected to pin 15 of each of the eight registers. When it is present, it clocks the data through the register exiting through pin 16 of IC-VV. From here, it goes through the control section

at IC-MM and on to the receiver.

The output register (Figure 9) performs the reverse operation. However, in order to separate it into words that are short enough for the ATAC, the data has to be multiplexed before it can be connected to the PIO bus. The Tri-State multiplexers, ICs -I through -L and -U through -X, and the required buffers, ICs -FE through -GG, were used to prevent interaction with the PIO bus when not in use. The timing here is more critical than in the input register system. Before the ATAC begins a read cycle from the output register, the clock signal to the register is stopped (DSP). This prevents the ATAC from reading non-stationary data. All the Tri-State multiplexers are addressed by connecting XAR bits 4 and 5 to pins 2 and 4 respectively. The commands DOA-DOD are ANDed together (NANDed and inverted) and the output connected to all the multiplexers as strobes at pins 1 and 15. When the ATAC reads a word, the XAR bits select the word and the strobe produces it during the microsecond when the PIO bus is available.

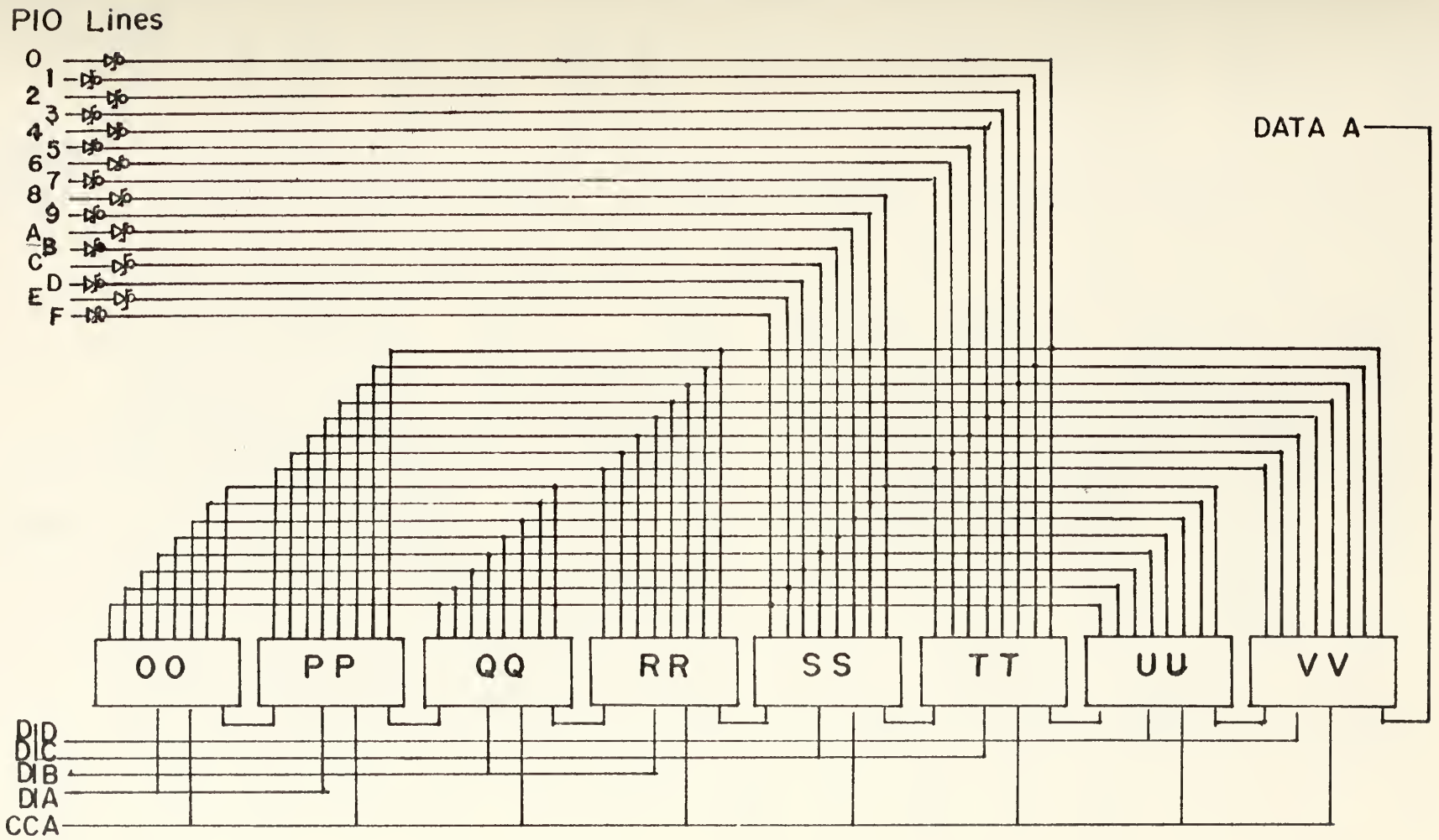


Figure 8
Input Register

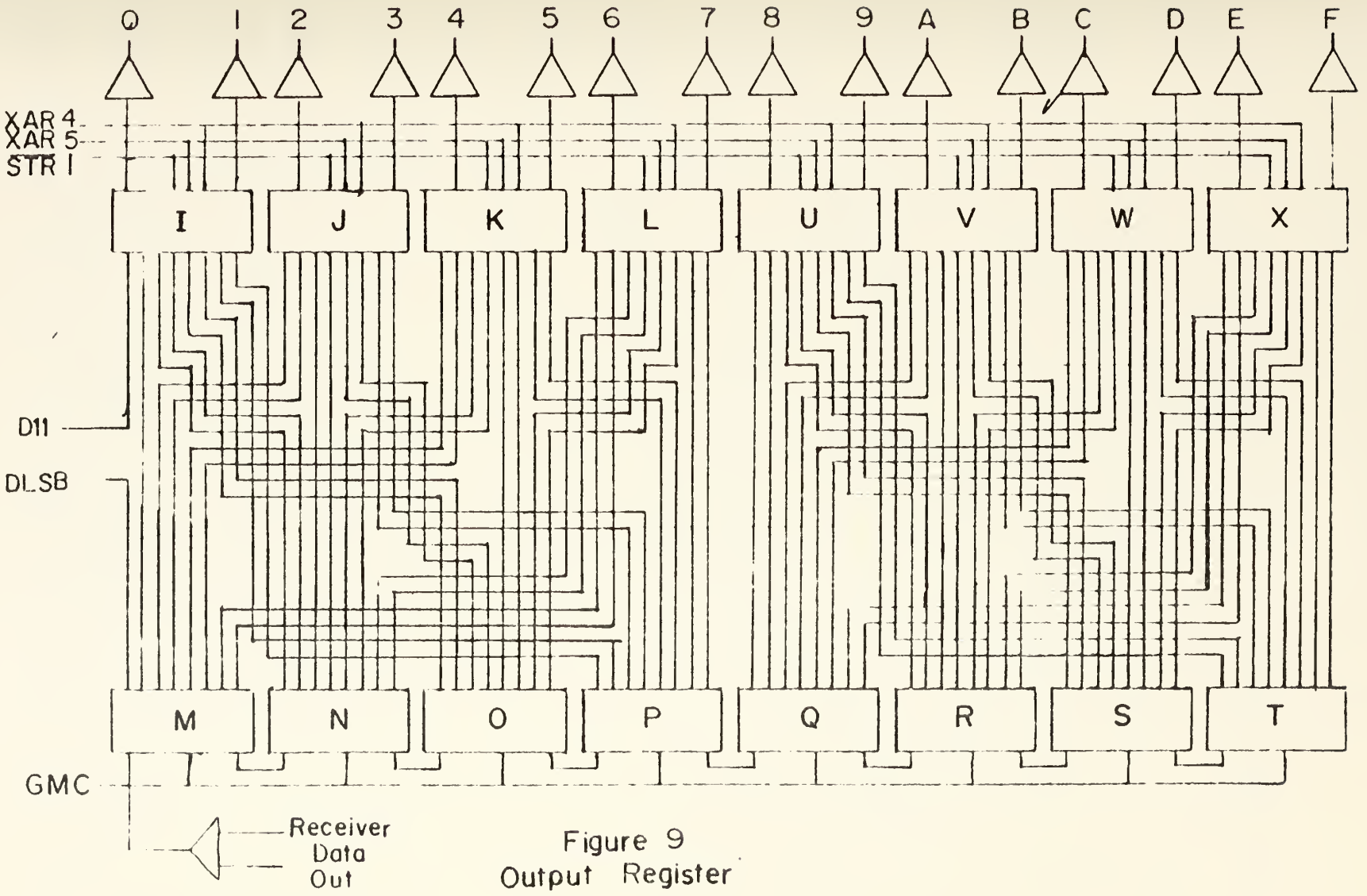


Figure 9
Output Register

V. THE PROGRAM

The ATAC program was written in two major sections; a system monitor and a control. The monitor is called the Main System and provides the operator the ability to program the ATAC from the operator's terminal. Receiver Control commands the interface and, therefore the receiver. Both programs were initially written prior to the construction of the interface, so many modifications were made using the Main System and its subroutines. After the interface was built and tested and the Receiver Control section modified to correctly contol the tuning of the receiver, the complete program was saved on paper tape (Appendix C). Operation of the computer is discussed in Appendix B and a sample run can be found in Appendix E.

A. THE MAIN SYSTEM

The Main System section consists of a small executive and a group of interconnected subroutines (Figure 10). The executive provides a basis for the subroutines when the receiver control program is not being executed. It is these subroutines that control the input and output to the operator terminal. The input routine is called KEYMR and the output routine, OUTPUT. OUTPUT converts correctly-formatted computer words into ASCII and displays them on the

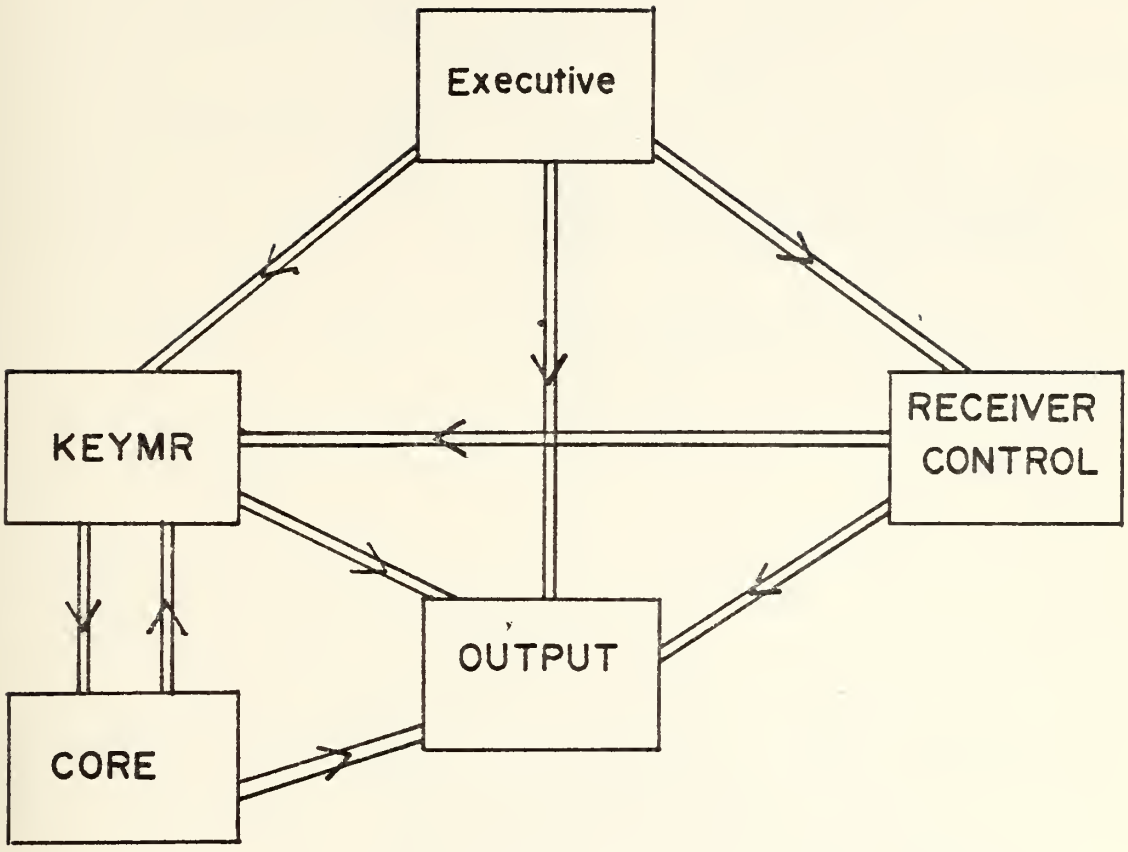


Figure 10

ATAC Program Block Diagram

I. CORE Commands

CO -- calls CORE from KEYMR.

a. DM 'address' -- displays 80 memory locations beginning with 'address'.

b. DI 'address' -- displays the contents of memory location 'address'.

c. CH 'address' 'value' -- Replaces the contents of memory at 'address' with 'value'.

d. CS 'address' -- Beginning at 'address', the contents of memory are replaced with the values typed on the lines following the command. Exit is accomplished by command DO.

e. DO -- Returns execution to CORE if in CS, otherwise returns to calling routine.

II. Receiver Control Commands

MJ -- Calls Receiver Control from the executive.

a. 0 -- Set-up - Routine to input values for entry into Receiver.

b. 1 -- Displays set-up control word.

c. 2 -- Displays last control word sent to receiver.

d. 3 -- Displays last control received from receiver.

e. 4 -- Sends set-up control word to receiver.

f. 5 -- Routine to input scan variables and execute a scan.

g. 6 -- Receive and Display control word from the receiver.

h. 7 -- Exit program and return to caller.

i. 8 -- Reinitialize program as if entering.

Table IV
AIAC Program Commands

terminal. KEYMR does the reverse, and stores the input in a buffer for use by the caller. KEYMR and OUTPUT were programmed to accept and display only uppercase letters, numerals, and a small number of needed symbols. But, because of the method employed to convert ASCII to machine code, it was found that each lower case letter entered from the keyboard was automatically mapped into its respective upper case twin. This relieves the operator of the responsibility of using the shift key. A part of the KEYMR, called COPE, is available for use by the operator to display and/or change sections of memory. The four available commands in this routine and their functions are displayed in Table IV. Care must be taken not to change memory locations which are used by the Main System. This could result in complete erasure of the AIAC's memory. Without KEYMR, OUTPUT, and COPE, or routines similiar to them, it would have been extremely difficult to perform any amount of troubleshooting or modification of the Receiver Control section.

B. RECEIVER CONTROL

This section of the system is a branch of the executive. Its main objective is to control both outputs and inputs of the interface from the operator's terminal. To assist those operators with little experience in this system, the Receiver Control section is equipped with uncomplicated

instructions and program safeguards. This produces almost foolproof operation but, it does so at the expense of program simplicity. Discussion of this section is separated into two parts. First a broad description of the complete section is discussed, followed by a detailed look at the two subroutines which interact with the interface.

When the Receiver Control program is entered, it performs five important actions. It initializes all necessary flags; enables the receiver and opens the MC gate; sends and receives a complete receiver word; and displays the instruction set to the operator. After this, it calls on KEYWR and waits for a command. When an input is delivered, the program checks its legality. If it is not a valid command, KEYWR is called again.

A valid command is a numeral between zero and eight (Table IV). These can be separated for discussion into three groups. The display group (0-3) inputs and exchanges information with the operator. The receiver group (4-6) performs operations with the receiver. The final group of commands (7-8) are used to exit or reinitialize the program. Group one has one input and three display commands. Command zero instructs the operator to input the parameters desired. It stores these parameters in memory in the display format, as opposed to control word format. Commands one, two, and three all display parameters. One displays the last parameters set-up by command zero. Two displays the last parameters sent to the receiver. Three displays the last

word received from the receiver. Commands seven and eight make up group three. Seven exits the program entirely and returns to the executive after disabling the receiver. Eight, on the other hand, returns the program to its beginning as if it had just been entered.

The remaining three commands are the most important. Group two commands control the actions of the interface. Command four converts the parameters set-up by command zero into control word format. It then calls the I/O subroutine described below, and outputs and inputs a receiver word. To merely receive a word from the receiver, command six is used. The program calls the input subroutine below and then exits to command three to display the parameters received. Command five scans a band of frequencies selected by the operator in search of a specified signal strength. All other parameters remain the same as those set-up by command zero.

With the exception of the instructions executed when entering and exiting Receiver Control, complete control of the interface and the receiver is resident in approximately forty computer instructions. These forty are grouped into the two subroutines WJR and WJS. WJS sends words to the receiver and WJR receives them. WJS loads the information and addresses to be sent to the receiver into the computer registers. The addresses are then matched to a word of data and sent to the interface input register. The routine now waits for the appropriate signal generated by RLP. When

this is received, a trigger command is sent to load the word into the receiver. At this point the routine checks the value of a counter. This test is to prevent the computer entering an infinite loop if either the interface or receiver is not turned on. If the test is unsatisfactory, the routine prints:

INFINITE LOOP
PLEASE CHECK RECEIVER AND INTERFACE

and reverts to operator control. If the test is satisfactory, the subroutine automatically continues to WJR. WJR loads another set of addresses into the computer registers. Here, a short wait for the RLP signal is necessary before any action is taken. The MC gate is closed immediately upon receipt of this signal. The receiver word is then loaded into the AIAC by outputting the address on the XAR lines and reading the data on the PIO lines. When the complete word is received, the MC gate is opened. At this point it is necessary to test for command six. This test determines whether the computer is sending and receiving or only receiving. If the execution of both WJS and WJR is being performed, a comparison between the word sent and the word received is necessary. This comparison is skipped if the computer is only executing WJR (command six). The first three control words sent by WJS and received by WJR are used for this comparison, when it is performed. If

any words differ, the computer returns to WJS to repeat the cycle until one of two conditions are met: either the words match or the WJS counter test discussed earlier fails. If the words match, WJP continues on to convert the received control words into the display format and then returns to the caller.

VI. RECOMMENDATIONS

The system as it stands now is but a beginning. Additions and modifications for future work should include; A/D converters for the receiver outputs; Morse and/or teletype decoders; and an expansion of the computer program. Implementation of either of the first two implies the third. There are some operator assistance program modifications that need to be made. The two that come immediately to mind are (1) a method to abort the scan routine from the operator's console, and (2) the ability to change individual parameters in addition to the set-up command already located in the program. Addition of the A/D converters implies a program increase to decode and process this new data. Switching routines and probably some hardware will be needed for the decoders. The capabilities of the system are limited only by the abilities of the operator and programmer.

VII. CONCLUSION

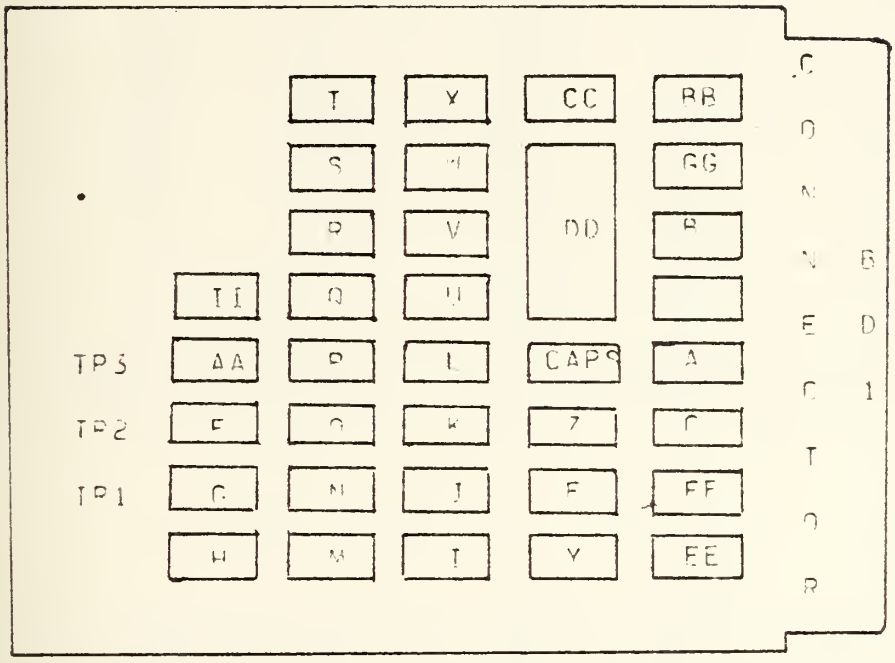
As long as the computer requires only that data obtained from the receiver's word, the interface is flexible enough to provide reliable results. At this time there are no known "bugs" in either the interface or the program. Both have been thoroughly tested to provide the operator with the most dependable system possible.

APPENDIX A

INTERFACE WIRING

A. Board 1

Integrated circuit locations (from Top of board).



Integrated Circuit

pin	A	B	C	F	F	G	H
1	8820	8820	8830	7476	7404	7400	74157
2	BD1-M	BD1-K	C-2/Z-3	VCC	M-3	BD2-E	DD-14
3	nc	nc	C-1/C-3	DD-8	H-3	Y-9	II-14
4	BD1-L	BD1-J	C-2/C-4	DD-15	A-6/Y-8	F-11	F-2
5	nc	nc	C-3	VCC	G-5	E-11	I-6
6	nc	nc	BD1-F	VCC	AA-6	F-4	nc
7	F-3/Y-8	M-1	BD1-H	VCC	G-12	F-9	nc
8	GRD	GRD	GRD	DD-7	GRD	GRD	GRD
9	nc	nc	nc	DD-6	I-8	nc	nc
10	nc	nc	nc	VCC	G-6	nc	nc
11	nc	nc	nc	nc	II-3	nc	nc
12	nc	nc	nc	G-4	G-3	F-13	nc
13	nc	nc	nc	VCC	I-15	F-6	nc
14	nc	nc	nc	GRD	G-11	DD-14	GRD
15	VCC	VCC	VCC	nc	VCC	VCC	VCC
16	xxxxxxxx	xxxxxxxx	xxxxxxxx	BD1-Y	xxxxxxxx	xxxxxxxx	xxxxxxxx
	xxxxxxxx	xxxxxxxx	xxxxxxxx	VCC	xxxxxxxx	xxxxxxxx	xxxxxxxx

Integrated Circuit

pin	I 7214	J 7214	K 7214	L 7214	M 74164	N 74164
1	X-15	I-15/J15	J-15/K15	K-15/L15	B-6/M-2	M-13/N-2
2	DD22/J-2	I-2/K-2	J-2/L-2	K-2/U-2	M-1	N-1
3	S-3	S-5	S-10	S-12	F-1	U-6
4	Q-3	Q-5	Q-10	Q-12	I-10	U-10
5	O-3	O-5	O-10	U-12	J-6	V-6
6	H-4	M-5	M-10	M-12	J-10	V-10
7	EE-1	FE-5	EE-11	FF-1	GRD	GRD
8	GRD	GRD	GRD	GRD	N-8	M-8/O-8
9	EE-3	FE-9	EE-13	FF-3	VCC	VCC
10	M-4	M-6	M-11	M-13	K-6	N-6
11	O-4	O-6	O-11	O-13	K-10	N-10
12	O-4	Q-6	O-11	Q-13	L-6	X-6
13	S-4	S-6	S-11	S-13	L-10	X-10
14	DD23/J14	K-14/I14	J-14/L14	K-14/U14	VCC	VCC
15	F-12/J-1	J-1/K-1	K-1/L-1	L-1/U-1	XXXXXXXX	XXXXXXXX
16	VCC	VCC	VCC	VCC	XXXXXXXX	XXXXXXXX

pin	U 74164	P 7416	Q 74164	R 74164	S 74164	T 74164
1	N-13/O-2	O-13/P-2	P-13/Q-2	Q-13/R-2	R-13/S-2	S-13/T-2
2	O-1	P-1	Q-1	R-1	S-1	T-1
3	T-5	U-5	T-4	U-4	T-3	U-3
4	T-11	U-11	T-12	U-12	T-13	U-13
5	J-5	V-11	J-4	V-4	J-3	V-3
6	J-11	V-11	J-12	V-12	J-13	V-13
7	GRD	GRD	GRD	GRD	GRD	GRD
8	N-8/P-8	O-8/Q-8	P-8/R-8	Q-8/S-8	R-8/T-8	S-8/F-8
9	VCC	VCC	VCC	VCC	VCC	VCC
10	K-5	N-5	K-4	N-4	K-3	N-3
11	K-11	N-11	K-12	N-12	K-13	N-13
12	L-5	X-5	L-4	X-4	L-3	X-3
13	L-11	X-11	L-12	X-12	L-13	X-13
14	VCC	VCC	VCC	VCC	VCC	VCC

Integrated Circuit

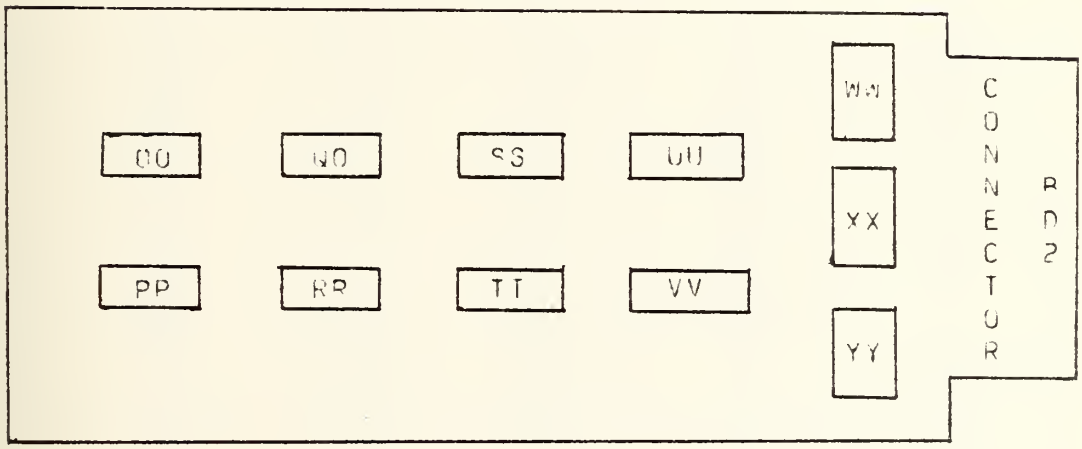
pin	U 7214	V 7214	W 7214	X 7214	Y 556	Z 555
1	L-15/U15	U-15/V15	V-15/W15	W-15/X15	Y2/Tr-1A	GRD
2	L-2/V-2	U-2/W-2	V-2/X-2	W-2	Y-1/HH-6	PD1-E
3	T-3	T-5	T-10	T-12	HH-5	C-1
4	R-3	R-5	R-10	R-12	VCC	VCC
5	P-3	P-5	P-10	P-12	BD1C/I11	HH-1
6	N-3	N-5	N-10	N-12	Y-9	HH-2/Z-7
7	FF-5	FF-11	GG-1	GG-5	GRD	Z6/Tr-3A
8	GRD	GRD	GRD	GRD	A-6/F-3	VCC
9	FF-9	FF-13	GG-3	GG-9	Y-6	XXXXXXXX
10	N-4	N-6	N-11	N-13	VCC	XXXXXXXX
11	P-4	P-6	P-11	P-13	HH-4	XXXXXXXX
12	R-4	R-6	R-11	R-13	Y-13/HH4	XXXXXXXX
13	T-4	T-6	T-11	T-13	Y12/Tr2A	XXXXXXXX
14	L-14/V14	U-14/W14	V-14/X14	W-14	VCC	XXXXXXXX
15	U-1/V-1	V-1/W-1	W-1/X-1	X-1/[-1	XXXXXXXX	XXXXXXXX
16	VCC	VCC	VCC	VCC	XXXXXXXX	XXXXXXXX

pin	AA 7420	BB 74s04	CC 74s04	EE 7407	FF 7407	GG 7407	HH CAPS	II 7476
1	DD-10	CC-6	BD1-17	I-7	L-7	W-7	Z-5	Y-5
2	DD-11	DD-18	DD-23	BD1-1	BD1-7	PD1-13	Z-6	VCC
3	nc	BD1-21	nc	I-9	L-9	W-9	Y-11	E-10
4	DD-9	BB-5	nc	BD1-2	BD1-8	BD1-14	Y-12	VCC
5	DD-13	BB-4	BD1-T	J-7	U-7	X-7	Y-3	nc
6	E-5	DD-19	BB-1	BD1-3	BD1-9	BD1-15	nc	nc
7	GRD	GRD	GRD	GRD	GRD	GRD	Y-2	nc
8	nc	DD-20	nc	BD1-4	BD1-10	BD1-16	GRD	nc
9	nc	BD1-20	nc	J-9	U-9	X-9	GRD	nc
10	nc	DD-21	nc	BD1-5	BD1-11	nc	GRD	nc
11	nc	BD1-19	nc	K-7	V-7	nc	GRD	nc
12	nc	DD-22	nc	BD1-6	BD1-12	nc	GRD	nc
13	nc	BD1-18	nc	K-9	V-9	nc	GRD	GRD
14	VCC	VCC	VCC	VCC	VCC	VCC	GRD	H-2
15	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	nc
16	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	GRD

Integrated Circuit

		DD 74154	
pin		pin	
1	RD1-P	13	AA-5
2	RD1-X	14	G-13/H-1
3	RD1-N	15	nc
4	RD1-V	16	nc
5	RD1-U	17	E-3
6	E-8	18	BB-2
7	E-7	19	BB-6
8	E-2	20	BB-8
9	AA-4	21	BB-10
10	AA-1	22	BB-12/I-2
11	AA-2	23	CC-2/I-14
12	GRD	24	VCC

II. Board 2
Integrated Circuit locations (from Top of board)



Integrated Circuit

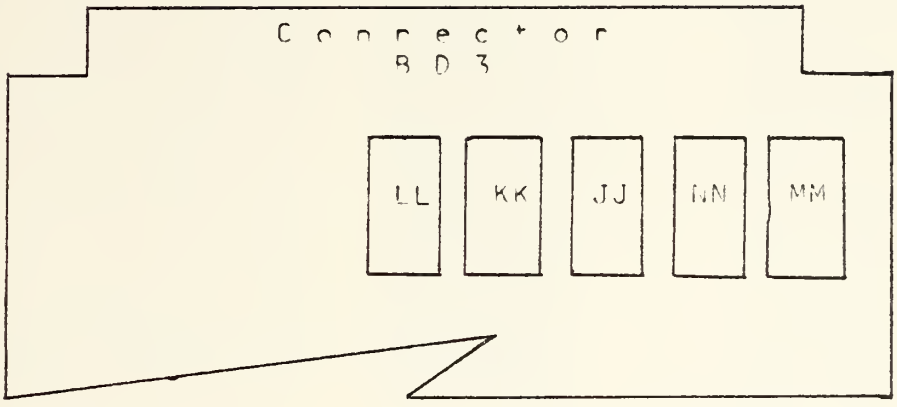
pin	OO 74165	PP 74165	QQ 74165	RR 74165	SS 74165	TT 74165
1	BD2-A	BD2-A	BD2-B	BD2-B	BD2-C	BD2-C
2	GRD	GRD	GRD	GRD	GRD	GRD
3	WW-2	YY-6	WW-2	YY-6	WW-2	YY-6
4	WW-12	YY-4	WW-12	YY-4	WW-12	YY-4
5	WW-4	YY-2	WW-4	YY-2	WW-4	YY-2
6	WW-10	YY-10	WW-10	YY-10	WW-10	YY-10
7	nc	nc	nc	nc	nc	nc
8	GRD	GRD	GRD	GRD	GRD	GRD
9	PP-10	QQ-10	PP-10	SS-10	TT-10	UU-10
10	VCC	OO-9	PP-9	QQ-9	RR-9	SS-9
11	XX-2	XX-4	XX-2	XX-4	XX-2	XX-4
12	XX-12	XX-6	XX-12	XX-6	XX-12	XX-6
13	WW-8	XX-8	WW-8	XX-8	WW-8	XX-8
14	WW-6	YY-12	WW-6	YY-12	WW-6	YY-12
15	BD2-21	BD2-21	BD2-21	BD2-21	BD2-21	BD2-21
16	VCC	VCC	VCC	VCC	VCC	VCC

pin	UU 74165	VV 74165	WW 74s04	XX 74s04	YY 74s04
1	BD2-D	BD2-D	BD2-17	BD2-10	BD2-4
2	GRD	GRD	OO-3 *	OO-11 *	PP-5 *
3	WW-2	YY-6	BD2-15	BD2-9	BD2-3
4	WW-12	YY-4	OO-5 *	PP-11 *	PP-4 *
5	WW-4	YY-2	BD2-13	BD2-8	BD2-2
6	WW-10	YY-10	OO-14 *	PP-12 *	PP-3 *
7	nc	nc	GRD	GRD	GRD
8	GRD	GRD	OO-13 *	PP-13 *	nc
9	VV-10	BD2-K	BD2-12	BD2-7	nc
10	TT-9	UU-9	OO-6 *	nc	PP-6 *
11	XX-2	XX-4	BD3-14	nc	BD2-5
12	XX-12	XX-6	OO-4 *	OO-12 *	PP-14 *
13	WW-8	XX-8	BD2-16	BD2-11	BD2-6
14	WW-6	YY-12	VCC	VCC	VCC
15	BD2-21	BD2-21	XXXXXXXXX	XXXXXXXXX	XXXXXXXXX
16	VCC	VCC	XXXXXXXXX	XXXXXXXXX	XXXXXXXXX

* - bus connection - only first connection shown

C. Board Three

Integrated circuit locations (from Top of board)



Integrated Circuit

pin	JJ	KK	LL	MM	NN
1	BD3-1	VCC	LL-2/JJ-7	BD3-1	BD3-5
2	KK-15	BD3-11	LL-1/LL-3	BD3-17	nc
3	BD3-6	BD3-12/20	LL-2/LL-4	BD3-16	BD3-4
4	LL-10	nc	LL-3	JJ-12	nc
5	BD3-8	VCC	BD3-7	GRD	nc
6	BD3-9	nc	BD3-10	BD3-16	MM-9
7	LL-1	nc	GRD	GRD	GRD
8	GRD	nc	BD3-19	BD3-2	nc
9	BD3-13	nc	BD3-18	NN-8	nc
10	BD3-14	nc	LL11/JJ-4	BD3-1	nc
11	nc	nc	LL12/LL10	BD3-3	nc
12	MM13/MM-4	nc	LL13/LL11	MM-9	nc
13	GRD	GRD	LL-12	JJ-12	nc
14	KK-15	nc	VCC	VCC	VCC
15	GRD	JJ-2/JJ14	xxxxxxxxx	xxxxxxxxx	xxxxxxxxx
16	VCC	nc	xxxxxxxxx	xxxxxxxxx	xxxxxxxxx

D. Connectors

Circuit Board Edge-connectors

	BD1	BD2	BD3
1	EE-2/BD2-10/CN1-2	GRD	SW1/JJ-1/MM-10
2	EE-4/BD2-11/CN1-3	YY-5/BD1-13	MM-8/BD2-21
3	EF-6/BD2-12/CN1-4	YY-3/BD1-14	MM-11/CN3-1
4	EE-8/BD2-13/CN1-5	YY-1/BD1-15	NN-2/CN2-2
5	EE10/BD2-17/CN1-6	YY-11/BD1-16	NN-1/CN2-3
6	EE12/BD2-16/CN1-7	YY-13/BD1-12	JJ-3/BD1-Y
7	FF-2/BD2-15/CN1-8	XX-9/BD1-11	LL-5/CN2-10
8	FF-4/BD2-14/CN1-9	XX-5/BD1-10	JJ-5/CN3-2
9	FF-6/BD2-9/CN1-10	XX-3/BD1-8	JJ-6/BD2-K
10	FF-8/BD2-8/CN1-11	XX-1/BD1-1	LL-6/CN2-11
11	FF10/BD2-7/CN1-12	XX-13/BD1-2	KK-2/CN3-3
12	FF12/BD2-6/CN1-13	WW-9/BD1-3	KK-3/CN3-4
13	GG-2/BD2-2/CN1-25	WW-5/BD1-4	JJ-9/BD1-E
14	GG-4/BD2-3/CN1-24	WW-11/BD1-8	JJ-10/BD1-P
15	GG-6/BD2-4/CN1-23	WW-3/BD1-7	JJ-11/CN3-5
16	GG-8/BD2-5/CN1-22	WW-13/BD1-6	nc
17	CC-1/CN1-11	WW-1/BD1-5	nc
18	BB-13/CN1-17	nc	LL-9/CN2-12
19	BB-11/CN1-19	nc	LL-8/CN2-11
20	BB-9/CN1-16	nc	KK-3/RESET
21	BB-3/CN1-20	DD-15/BD3-2	nc
22	nc	GRD	VCC
A	GRD	DD-1/BD1-X	GRD
B	nc	GG-1/BD1-W	nc
C	II-14/CN3-6	SS-1/BD1-V	nc
D	nc	UU-1/BD1-U	nc
E	7-2/BD3-13	nc	nc
F	C-5/CN2-9	nc	nc
H	C-6/CN2-8	nc	nc
J	B-3/CN2-7	nc	nc
K	B-1/CN2-6	nc	nc
L	A-3/CN2-5	nc	nc
M	A-1/CN2-4	nc	nc
N	nc	nc	nc
P	DD-1/BD3-14	nc	nc
R	nc	nc	nc
S	nc	nc	nc
T	CC-5/CN1-14	nc	nc
U	DD-5/BD2-D	nc	nc
V	DD-4/BD2-C	nc	nc
W	DD-3/BD2-B	nc	nc
X	DD-2/BD2-A	nc	nc
Y	E-15/BD3-6	nc	nc
Z	vCC	nc	nc

Cabinet Connectors

pin	CN1	CN2	CN3
1	GRD	GRD	BD3-3 "CCK"
2	BD1-1 "PIO 0"	BD3-4 "CC - "	BD3-8 "DATA K"
3	BD1-2 "PIO 1"	BD3-5 "CC + "	BD3-11 "KAC"
4	BD1-3 "PIO 2"	BD1-M "MC - "	BD3-12 "KAF"
5	BD1-4 "PIO 3"	BD1-L "MC + "	BD3-15 "TRK"
6	BD1-5 "PIO 4"	BD1-K "DO - "	BD1-3 "RLD"
7	BD1-6 "PIO 5"	BD1-J "DO + "	nc
8	BD1-7 "PIO 6"	BD1-H "TR - "	nc
9	BD1-8 "PIO 7"	BD1-F "TR + "	nc
10	BD1-9 "PIO 8"	BD3-7 "DI - "	nc
11	BD1-10 "PIO 9"	BD3-10 "DI + "	nc
12	BD1-11 "PIO 10"	BD3-1 "AD - "	nc
13	BD1-12 "PIO 11"	BD3-13 "AD + "	nc
14	BD1-T "IOD"	nc	GRD
15	nc	nc	nc
16	BD1-17 "XAR 4"	nc	nc
17	BD1-18 "XAR 5"	nc	nc
18	BD1-20 "XAR 6"	nc	nc
19	BD1-19 "XAR 8"	nc	nc
20	BD1-21 "XAR 13"	nc	nc
21	nc	nc	nc
22	BD1-16 "PIO-15"	nc	nc
23	BD1-15 "PIO-14"	nc	nc
24	BD1-14 "PIO-13"	nc	nc
25	BD1-13 "PIO-12"	nc	nc

E. Discrete Components

Capacitors

.01 uF	HH-1/HH-14
.2 uF	HH-2/HH-13
.20 uF	HH-3/HH-12
.01 uF	HH-4/HH-11
.01 uF	HH-5/HH-10
.47 uF	HH-7/HH-8

Resistors

	Trimmer 1	2	3
A	Y-1	Y-13	Z-7
B	VCC	VCC	VCC
C	VCC	VCC	VCC

APPENDIx B
ATAC OPERATING INSTRUCTIONS

Power Up
    Turn on front panel power then turn on power supplies.

Power Down
    'Halt'
    'Master Clear'
    Power off to supplies, power off to control
    panel.

Run Program
    'Master Clear'
    Dial 'IMR'
    'AUX REG'
    'ENTER' (associated with AUX REG)
    'MEMORY'
    Set start address +1 in keyboard (Hexadecimal)
    'PCR'
    'ENTER' (associated with PCR)
    'RUN'

Stop a Program
    'HALT'

Read Memory (from front panel)
    'HALT'
    Set desired address in key board
    Select 'MAR'
    'ENTER' (associated with MAR)
    'INC' (increment)
    'DEC' (decrement)
    Address is displayed above MAR key, data is disolayed in
        red LEDs above MEMORY key.
    Use INC or DEC as necessary to arrive at memory location
        desired.

Write into Memory (from front panel)
    'HALT'
    Set address desired as described in Read Memory.
    Set desired data into keyboard
    'ENTER' (associated with MEMORY)
    Value in keyboard will be entered into either Memory
        (MEMORY) or A computer Register (FILE).

Bootstrap Load (paper tape)

'HALT'
'MASTER CLEAR'
'AUX REG'
Dial 'IMR'
'ENTER' (associated with AUX REG)
'MEMORY'
Set 0001 in keyboard
(0001 = Load, 0002 = Verify only)
'RUN'
At end of tape check program status lights (red LEDs below PCR and MAR pushbuttons)

0000 = Load good
FFFE = Parity error
FFFD = Verify error

APPENDIX C

ATAC PROGRAM ASSEMBLY

Assembly of a program is divided into five parts; writing, producing absolute deck on IBM 360, conversion of absolute deck into ATAC format, punching paper tape, and loading ATAC.

A. Writing the program.

Programs for the ATAC must be written in the assembly language described in ATAC manuals Volumes One, and Eight. The finished program must be placed on cards for the IBM 360 in the following format:

B. Producing an absolute deck

The first step is to load the assembler on to the IBM 360 from magnetic tape. This is done by executing program A in Appendix E. This transfers the program from tape to disk and saves it for one year. Once the assembler is stored the

following cards placed in the front of a program written following the instructions in I above will produce an absolute deck and a print-out of the program.

```
//ATACASSM JOB (0729,0194,0052),'CCH ATAC ASSEM,',TIME=1
//ASSEM    EXEC PGM=APSS,REGION=220K
//STEPLIB DD  DSN=S0729.ATAC.ONE,UNIT=3330,
//              VOL=SER=DISK02,DISP=SHR
//FT06F001 DD   SYSOUT=A
//FT07F001 DD   SYSOUT=B
//FT05F001 DD   DDNAME=SYSIN
//FT08F001 DD   UNIT=SYSDA,SPACE=(CYL,1)
//FT09F001 DD   UNIT=SYSDA,SPACE=(CYL,(7,2)),
//              DCB=(RECFM=VBS,BLKSIZE=7180,LRECL=92)
//FT10F001 DD   UNIT=SYSDA,SPACE=(CYL,(7,2)),
//              DCB=(RECFM=VBS,BLKSIZE=4204,LRECL=42)
//FT20F001 DD   UNIT=SYSDA,SPACE=(CYL,(7,2)),
//              DCB=(RECFM=VBS,BLKSIZE=2004,LRECL=500)
//SYSPRINT DD   SYSOUT=A
//SYSIN    DD   *
$JOB
$ASSEM
         IDT   ATAC

(place written program here.)

         END
$BASE
$LOAD    P
$END
```

The absolute deck is in the form:

```
0500169c0009adbc3109bc9c3109c8bc7109c09c7109a8b60309bbd932/
                                                  /e1010000 9c015a
0510160 9f49c0109f6ed0008aee1010a02ed000230e10109f7ed0007ae/
                                                  /c1070509201258
```

which must be translated for the ATAC. The memory location of the first word is located in the first four columns.

Columns five and six contain the number of word fields on the card. The assembled program is located in columns 7 - 70. The remaining two columns are parity.

C. Conversion

The absolute deck received from the IBM 360 is loaded into the PDP-11. After the data from the cards is checked, the conversion program (convert 'filename' 'filename') can be executed. (Program C in Appendix F)

D. Punching Paper Tape

This code must then be transferred to the PDP-11 (A) where a paper tape can be punched. Here, the command to punch a tape is:

cat 'filename' >/dev/ptp

E. Loading the ATAC

In order to load a tape the RS232 connector must be connected to the Paper Tape reader and the reader set to 1200 baud. The tape is loaded by following the instructions in Appendix B.

APPENDIX D

SAMPLE ATAC OUTPUT

Operator inputs are underlined.

```
Operator Display                        *Comments

EXEC                                    *Executive echos
+JDKDKJFJjjnmun                         *entries other than
JDKDKJFJJJNMJH                          *commands

EXEC
+CO                                     *Entry into CORE

CORE
+CH 0F00 0900                           *Location 0F00
0F00  0900                              *changed to 0900

CORE
+DI 0F00
0F00  0900

CORE
+CS 0F00                                *Locations  0F00 to 0F03
+0256                                   *changed

+0123

+4567

+DO                                     *completion of change
0F00  0256
0F01  0123
0F02  4567

CORE
+DO                                     *Exit from CORE

+NJ                                     *Entry into Receiver
0=SET-UP                                *Control
1=DISPLAY TENTATIVE
2=DISPLAY CONTROL
3=DISPLAY RECEIVED
4=ENTER TENTATIVE
5=SCAN
```

6=RECEIVE CONTROL
7=DONE
8=REINITIALIZE

RECEIVER CONTROL
+0

FREQ(HZ)

+1240000
DETECT MODE
0=AM
1=FM
2=BFO FIXED
3=BFO VARIABLE
4=ISB
5=USB
6=LSB
7=AM-NL

+0
GAIN MODE
0=HOLD AGC
2=NORMAL AGC
3=MANUAL AGC

+0
IF BANDWIDTH
1=500 HZ
2=2 KHZ
3=4 KHZ
4=8 KHZ

+4
RF GAIN
(PERCENTAGE)

+88

RECEIVER CONTROL
+1
FREQ = 1240000 HZ
GAIN MODE = HOLD AGC
IF BANDWIDTH = 8 KHZ
DETECT MODE = AM
BFO FREQ = 455000 HZ
RF GAIN = 88%

RECEIVER CONTROL
+2

```
FREQ = 550000 HZ
GAIN MODE = NORMAL AGC
IF BANDWIDTH = 8 KHZ
DETECT MODE = AM
BFO FREQUENCY = 455000 HZ
RF GAIN = 85%

RECEIVER CONTROL
+3
FREQ = 550000 HZ
GAN MODE = NORMAL AGC
IF BANDWIDTH = 8 KHZ
DETECT MODE = AM
BFO FREQUENCY = 455000 HZ
RF GAIN = 85%
SIGNAL STRENGTH = 66%

RECEIVER CONTROL
+4

RECEIVER CONTROL
+5
SCAN
START FREQ IN HZ

+1000000
END FREQ IN HZ

+1008000
FREQ INCREMENT IN HZ

+1000
SIGNAL STRENGTH %

+67
FREQ = 1001000
GAIN MODE = HOLD AGC
IF BANDWIDTH = 8 KHZ
DETECT MODE = AM
BFO FREQUENCY = 455000 HZ
RF GAIN = 88%
SIGNAL STRENGTH = 72%

RECEIVER CONTROL
+7                                  *Exit from
EXEC                                *Receiver Control
+
```

APPENDIX E
CONVERSION PROGRAMS FOR THE ASSEMBLER

A. This program is run on the IBM-360 to transfer the ATAC assembler from tape ATT-006 to Disk and stores it there for one year.

```
// [GREEN JOB CARD]
//SYSPRINT DD   SYSOUT=A
//SYSUT1   DD   UNIT=SYSDA,SPACE=(TRK,(40),,CONTIG)
//DA1      DD   UNIT=2314,DSN=S0729.ATAC.ONE,
//              SPACE=(TRK,(50,10,10),,CONTIG),
//              DISP=(NEW,KEEP),VOL=SER=SPOOL3
//I1TAPE DD UNIT=(2400,,DEFER),DISP=(NEW,PASS),
//              LABEL=(3,SL,,IN),
//              DCB=(DEN=2,BLKSIZE=800,LRECL=80,RECFM=FB),
//              VOL=SER=ATT006
//SYSIN    DD   *
         COPY   PDS=ATI.APSS.LOADLIB,TO=2314=SPOOL3,
                FROMDD=I1TAPE,FROM=2400=(ATI006,3),
                RENAME=S0729.ATAC.ONE
/*
//BUILD    EXEC PGM=IEWL,REGION=150K,
//           PARM='OVLY,XREF,LET,LIST,SIZE=(256K,20480)'
//SYSPRINT DD   SYSOUT=A
//LIBRARY DD DSN=S0729.ATAC.ONE,UNIT=2314,VOL=SER=SPOOL3,
//              DISP=SHR
//SYSLIB DD DSNAME=SYS1.FORTLIB,DISP=SHR
//SYSLMOD DD DSNAME=S0729.ATAC.ONE,
//              UNIT=3330,VOL=SER=DISK02,
//              DISP=(NEW,KEEP),LABEL=RETPD=360,
//              SPACE=(CYL,(5,1,2),RLSE)
//SYSUT1 DD UNIT=SYSDA,SPACE=(TRK,(10,10),,CONTIG),
//              SEP=SYSLMOD
//SYSLIN   DD   *
 INCLUDE LIBRARY(PMODL)
 CHANGE MSIM(IHESAPD)
 INCLUDE LIBRARY(APSSMON)
 INCLUDE LIBRARY(MSIMM,ASEM5,SIM16A,SIMTR1,SIMIO1,GUL)
 INCLUDE LIBRARY(XPLMON)
 OVERLAY A1
 INSERT MSIMUL,*MSIMDLA,IHENTRY,IHESAP
 INSERT MINT,IN,OUT
 INSERT IHEDBN,IHEXTD
```

```
 INSERT IHERSM,IHECSM
 INSERT IHERSK,IHFIOX,IHEIOP,IHEDID,IHEDOB
 INSERT IHEDIR,IHEDCA,IHETOB
 INSERT IHEIOA,IHEOCL
 INSERT IHERSD,IHEBSF
 INSERT IHEJXS
 INSERT IHEOSD,IHEOST,IHERST
 INSERT IHEVPF,IHEDMA,IHEVFB
 INSERT IHEDNC,IHEVFD,IHEVFA,IHEVPD,IHEVPB,IHEVSC
 INSERT IHEVSD,IHEVFE,IHEDCN,IHEUPB
 INSERT IHEVFC,IHEVPE,IHEVPG,IHEVQB,IHEVQC
 INSERT IHEABN,IHEICD,IHETOF,IHEPRT,IHEVQA,IHESPRT
 INSERT IHEREG,IHEEPR,IHESIZ
 INSERT MTSET
 OVERLAY A1
 INSERT ASSEM,REWIND,REW72,DSKOUT,CARDIN,DISKIN,ERPRT,PRIADD
 INSERT WRDATA,PRTCOM,PRINOR,ARTTEX,REFTIT,PREF,EPTTT
 OVERLAY A1
 INSERT PARMRD,PRESIM
 OVERLAY A1
 INSERT SMLTR,GRMTRX,STRTSM,IPAGE
 INSERT RDCRD,ABNPMT,ARTHEP,TRACE,HGRAM,HGRAMI,HGRAMS
 INSERT IOINIT,ACTIVE,STMTIM
 INSERT DEVDTA,ACT,TIME,INT,RAND,DEADT,DEBUG
 OVERLAY A2
 INSERT LEVEL,DMAIOI,DMAIOA,DMAIOD,RIOIO
 INSERT REMACT,DMA,DMAIM,RIO,RIOIM,RIOINT,INIOLY,DMAINT
 INSERT DTRAN,PUTACT,RANDOM
 OVERLAY A1
 INSERT HGPRNT
 OVERLAY A1
 INSERT LOADER
 OVERLAY A1
 INSERT LINK,ENTEXT,SILH
 OVERLAY A1
 INSERT PLATAC,IOPACK
 OVERLAY $OBJECT(REGION)
 INSERT OBJECT,INIT,LIB,RCALPH,RCHEX,RCINT
 INSERT MDATE
 OVERLAY $DUMP(REGION)
 INSERT SMDUMP,PAGE
 ENTRY MAIN
 NAME APSS
/*
//          EXEC PGM=IEBCOPY
//SYSPRINT DD   SYSOUT=A
//SYSUT1   DD   DISP=SHR,UNIT=2314,VOL=SER=SPOOL3,
//              DSN=S0729.ATAC.ONE
//SYSUT2 DD DISP=(NEW,PASS),UNIT=3330,VOL=SER=DISK02,
//           DSN=S0729.ATAC.TWO,
```

```
//            SPACE=(13030,(01,0,14),RLSE),
//               DCB=(RECFM=U,BLKSIZE=13030),
//               ,LABEL=RETPD=360
//SYSUT3    DD   UNIT=SYSDA,SPACE=(TRK,(20,5))
//SYSUT4    DD   UNIT=SYSDA,SPACE=(TRK,(20,5))
//SYSIN     DD   *
            COPY OUTDD=SYSUT2,INDD=SYSUT1
```

6. This program converts the IBM-360 absolute deck into correct format for the ATAC.

```
main (argc, *argv)
   int argc;
   char *argv [];
   {register crctr, index, index;
    int stchr;
    int tmpry [731;
    struct buffr
       {int flges;
        int nleft;
        char *nextp;
        char *buffs [512];
       } bufin, bufot, *pntr1, *pntr2;
    stchr = 020;
    if (argc != 3)
       {printf ("Calling arguments are incorrect#");
        exit (0);
       }
    bufin.flges = open (argv [1], 0);
    if (bufin.flges < 0)
       {printf ("Cannot open %s#", argv [1]);
        exit (0);
       }
    pntr1 = &bufin.flges;
    bufot.flges = creat (argv [2], 0777);
    if (bufot.flges < 0)
       {printf ("Cannot open %s#", argv [2]);
        exit (0);
       }
    pntr2 = &bufot.flges;
    putc (stchr, pntr2);
    while (crctr >= 0 && index <= 72)
        tmpry [index++] = (crctr = getc (pntr1));
    index -= 3;
    jndex = 0;
    while (jndex < 4 && jndex < index)
```

```
        putc (tmpry [jndex++], pntr2);
    jndex = jndex + 2;
    while (crctr >= 0)
       {while (jndex < index)
           {if (tmpry [jndex] == '#')
                jndex++;
              else
                putc (tmpry [jndex++], pntr2);
           }
        index = 0;
        while (crctr >= 0 && index <= 72)
            tmpry [index++] = (crctr = getc (pntr1));
        index -= 3;
        jndex = 0;
       }
    putc (stchr, pntr2);
    fflush (pntr2);
    close (bufin._flags);
    close (bufot._flags);
   }
```

C. The following program executes the program above and converts the output into the correct code.

```
atac $1 $2
if ! -r $2 exit
mv $2 temp2
tr "[0*]" "[040*]" <temp2 >temp1
tr "[1*]" "[001*]" <temp1 >temp2
tr "[2*]" "[002*]" <temp2 >temp1
tr "[3*]" "[043*]" <temp1 >temp2
tr "[4*]" "[004*]" <temp2 >temp1
tr "[5*]" "[045*]" <temp1 >temp2
tr "[6*]" "[046*]" <temp2 >temp1
tr "[7*]" "[007*]" <temp1 >temp2
tr "[8*]" "[010*]" <temp2 >temp1
tr "[9*]" "[051*]" <temp1 >temp2
tr "[a*]" "[052*]" <temp2 >temp1
tr "[b*]" "[013*]" <temp1 >temp2
tr "[c*]" "[054*]" <temp2 >temp1
tr "[d*]" "[015*]" <temp1 >temp2
tr "[e*]" "[016*]" <temp2 >temp1
tr "[f*]" "[057*]" <temp1 >$2
rm temp1 temp2
```

APPENDIX F

ATAC PROGRAM

The following programs are listings of the Main System and Receiver Control programs for the ATAC. The assembly language is to the right of the absolute listing of the first three columns.

```
LOC   OBJECT CODE     CARD IMAGE                                                                    CARDNUM
                            IDT    ATAC                                                                    1
0000                        DS     0100                                                                    2
                            ENTRY  EXEC                                                                    3
                      WJ    EQU    0500                                                                    4
                      .                                                                                    5
                      .                                                                                    6
                      .                                                                                    7
                      .                                                                                    8
                      .*************************************************************                       9
                      . EXEC                                                        *                      10
                      .                                                             *                      11
                      . EXECUTIVE PROGRAM FOR SYSTEM.  HANDLES REQUESTS SUBMITTED*                         12
                      . THROUGH KEYMR                                               *                      13
                      .*************************************************************                      14
                      .                                                                                    15
                      . *****************                                                                  16
                      . ESTABLISH EQUATES                                                                  17
                      . *****************                                                                  18
                      .                                                                                    19
                      EADD    EQU   1                    ADDRESS OF INPUT BUFFER                           20
                      EZ      EQU   2                    CONSTANT ZERO                                     21
                      EONE    EQU   3                    CONSTANT ONE                                      22
                      EL      EQU   4                    LOWER BYTE OF REQUEST                             23
                      EXCAD   EQU   5                    ADDRESS OF REQUESTED ROUTINE                      24
                      EU      EQU   6                    UPPER BYTE OF REQUEST                             25
                      EC      EQU   7                    COUNT OF WORDS IN BUFFER                          26
                      .                                                                                    27
                      .                                                                                    28
                      .                                                                                    29
                      .                                                                                    30
                      . *********                                                                          31
                      . EXECUTIVE                                                                          32
                      . *********                                                                          33
                      .                                                                                    34
0100  E201 014D    EXEC  LDR    D,EADD,ETITLE         GET TITLE ADDRESS                                   35
0102  ED00 0230          BAL    I,0,OUTPUT            OUTPUT TITLE                                        36
0104  ED00 0151          BAL    I,RET,KEYMR           GET PROGRAM REQUEST                                 37
0106  9CF0 0136          STRM   D,0,EXECS,16          SAVE ALL REGISTERS                                  38
                      .                                                                                    39
                      . GET FIRST TWO LETTERS OF REQUEST                                                   40
                      .                                                                                    41
0108  4013               LDR    IS,EONE,1             SET UP CONSTANT                                     42
0109  4002               LDR    IS,EZ,0               SET UP CONSTANT                                     43
010A  5217               LDR    RX,EC,EADD,EZ         GET COUNT OF WORDS IN BUFFER                        44
010B  6011          EX1  ADD    IS,EADD,1             INCREMENT BUFFER POINTER                            45
010C  5216               LDR    RX,EU,EADD,EZ         GET WORD FROM BUFFER                                46
010D  6FF7               ADD    IS,EC,-1              DECREMENT WORD COUNT                                47
010E  C106 0100          BRCL   NP,EXEC               GET OUT IF NOT THERE                                48
0110  2206               CMP    IS,EU,020             COMPARE WITH SPACE                                  49
0111  C102 010B          BRCL   EQ,EX1                IF SPACE, KEEP LOOKING                              50
0113  AE76               SHS    LL,EU,8               POSITION UPPER BYTE                                 51
0114  5314               LDR    RX,EL,EADD,EONE       GET NEXT WORD IN BUFFER                             52
0115  AE74               SHS    LL,EL,8               CLEAR UPPER BYTE                                    53
0116  AD74               SHS    RL,EL,8               POSITION LOWER BYTE                                 54
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
0117  A446                    IOR   R,EU,EL          COMBINE FIRST TWO BYTES OF COMMAND      55
                      .                                                                       56
0118  B106 776A               CMP   I,EU,0776A       SEE IF REQUEST FOR WJ                   57
011A  C102 012A               BRCL  EQ,EX2           GO CALL WJ                              58
                      .                                                                       59
011C  0000                    NOP                    PATCH AREA FOR ANOTHER REQUEST          60
011D  0000                    NOP                                                            61
011E  0000                    NOP                                                            62
011F  0000                    NOP                                                            63
                      .                                                                       64
                      . ECHO EXIT - INVALID REQUEST                                         65
                      .                                                                       66
0120  BCF0 0136               LDRM  D,0,EXECS,16     RESTORE REGISTERS                       67
0122  ED00 0230               BAL   I,0,OUTPUT       ECHO INPUT BUFFER                       68
0124  E101 014A               LDR   I,1,EXCRLF       GET ADDRESS OF CR/LF BUFFER             69
0126  ED00 0230               BAL   I,0,OUTPUT       OUTPUT CR/LF                            70
0128  C107 0100               BRC   I,7,EXEC         GO TRY AGAIN                            71
                      .                                                                       72
                      . CALL RECEIVER CONTROL PROGRAM                                       73
                      .                                                                       74
012A  ED00 0500     EX2       BAL   I,RET,WJ         GO TO WJ                                75
012C  C107 0100               BRCL  U,EXEC                                                   76
                      .                                                                       77
                      . PATCH AREA FOR ANOTHER REQUEST                                      78
                      .                                                                       79
012E  0000                    NOP                                                            80
012F  0000                    NOP                                                            81
0130  0000                    NOP                                                            82
0131  0000                    NOP                                                            83
0132  0000                    NOP                                                            84
0133  0000                    NOP                                                            85
0134  C107 0100               BRCL  U,EXEC                                                   86
                      .                                                                       87
                      .                                                                       88
                      .                                                                       89
                      .                                                                       90
                      . ****                                                                91
                      . DATA                                                                92
                      . ****                                                                93
                      .                                                                       94
0136                  EXECS   DS    20               SAVE AREA FOR REGISTERS                 95
                      .                                                                       96
014A  0001            EXCRLF  DC    1                                                       97
014B  0D0A                    DC    0D0A             CR/LF                                   98
014C  0000                    DC    0                                                       99
014D  0003            ETITLE  DC    3                COUNT                                  100
014E  4558                    DC    04558            EX                                     101
014F  4543                    DC    04543            EC                                     102
0150  0000                    DC    0                NULL                                   103
                      .                                                                      104
                      .                                                                      105
                      .                                                                      106
                      .                                                                      107
```

```
LOC   OBJECT CODE      CARD IMAGE                                                   CARDNUM
                       . *************************************************************
                       . SYSTEM EQUATES                                              *
                       .                                                             *
                       . THESE ARE EQUATES THAT ARE USED FOR LINKAGE BETWEEN         *
                       . PROGRAMS OR THAT ARE USED BY AT LEAST TWO PROGRAMS IN       *
                       . THE SYSTEM                                                  *
                       . *************************************************************
                       .
                       RET       EQU   0                   RETURN REGISTER
                       .
                       .
                       . *************************************************************
                       . KEYMR                                                       *
                       .                                                             *
                       . ROUTINE TO READ DATA FROM THE KEYBOARD                      *
                       .                                                             *
                       . CALLING PROCEDURE:                                          *
                       .         BAL    I,0,KEYMR                                    *
                       .                                                             *
                       . INPUTS:                                                     *
                       .        NONE                                                 *
                       .                                                             *
                       . OUTPUTS:                                                    *
                       .     REG 1       ADDRESS OF BUFFER CONTAINING THE KEYBOARD   *
                       .                 ENTRY (ONE CHARACTER PER WORD, RIGHT        *
                       .                 JUSTIFIED, ASCII)                           *
                       .                 THE FIRST WORD OF THE BUFFER CONTAINS THE   *
                       .                 NUMBER OF CHARACTERS IN THE KEYBOARD        *
                       .                 ENTRY BUFFER                                *
                       .                                                             *
                       . ROUTINES CALLED:                                            *
                       .     OUTPUT                                                  *
                       .                                                             *
                       . THIS ROUTINE PRESERVES NO REGISTERS                         *
                       . *************************************************************
                       .
                       .
                       .
                       . ****************
                       . ESTABLISH EQUATES
                       . ****************
                       .
                       KRET      EQU   0                   RETURN REGISTER
                       KBUF      EQU   1                   ADDRESS OF BUFFER HOLDING KEYBOARD
                       .                                   ENTRY
                       KPC       EQU   5                   POSITION COUNTER FOR NEXT INPUT
                       .                                   INPUT FROM KEYBOARD (CURSOR)
                       KPM       EQU   6                   MAX POSITION USED IN KEYBOARD ENTRY
                       .                                   (NUMBER OF CHARACTERS ENTERED)
                       KOR       EQU   7                   OUTPUT REGISTER
                       KIR       EQU   8                   INPUT REGISTER
                       KOUT      EQU   9                   OUTPUT DEVICE ADDRESS
                       KIN       EQU   10                  INPUT DEVICE ADDRESS
                       KV1       EQU   11                  VARIABLE 1
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
                      KV2       EQU   12                VARIABLE 2                      161
                      KV3       EQU   13                VARIABLE 3                      162
                      KDATA     EQU   14                INPUT DATA FROM KEYBOARD        163
                                .                                                       164
                                .                                                       165
                                .                                                       166
                                .                                                       167
                                . **********************                              168
                                . INITIALIZE AND SET UP                                 169
                                . **********************                              170
                                .                                                       171
0151  9C00 01D6   KEYMR     STR   D,KRET,RETURN     SAVE RETURN ADDRESS             172
0153  E101 0228   KMR1      LDR   I,KBUF,KBSTRT     GET ADDRESS OF BUFFER TO OUTPUT 173
0155  ED00 0230              BAL   I,KRET,OUTPUT     OUTPUT INITIAL BUFFER           174
0157  E10A FFBF              LDR   I,KIN,0FFBF       DEVICE ADDRESS FOR INPUT        175
0159  E109 BFFF              LDR   I,KOUT,0BFFF      DEVICE ADDRESS FOR OUTPUT       176
015B  4015                   LDR   IS,KPC,1          POSITION COUNTER = 1            177
015C  4016                   LDR   IS,KPM,1          MAX POSITION USED = 1           178
015D  E101 01D7              LDR   I,KBUF,KBUFFER    ADDRESS OF BUFFER TO REGISTER   179
015F  E107 8000              LDR   I,KOR,08000       RESET CODE                      180
0161  D997                   ROUT  KOR,KOUT          RESET KEYBOARD                  181
                                .                                                       182
                                . ************************************                  183
                                . SET KEYBOARD ENTRY BUFFER TO ALL SPACES               184
                                . ************************************                  185
                                .                                                       186
0162  450B                   LDR   IS,KV1,80         SET COUNTER TO BUFFER LENGTH    187
0163  E01C                   LDR   R,KV2,KBUF        GET BUFFER ADDRESS              188
0164  420D                   LDR   IS,KV3,020        CODE FOR SPACE                  189
0165  1BCD         KMR2      STR   RX,KV3,KV2,KV1    STORE BLANK CODE                190
0166  6FFB                   ADD   IS,KV1,-1         DECREMENT COUNTER               191
0167  C101 0165              BRCL  GT,KMR2           DO AGAIN IF COUNTER GT 0        192
                                .                                                       193
                                . **********************                              194
                                . GET DATA FROM KEYBOARD                                195
                                . **********************                              196
                                .                                                       197
0169  E107 8000    KMR3      LDR   I,KOR,08000       RESET CODE                      198
016B  D997                   ROUT  KOR,KOUT          RESET KEYBOARD                  199
                                .                                                       200
016C  8CAE         KMR4      RIN   KDATA,KIN         GET DATA                        201
016D  9E0E 4000              CMPL  I,KDATA,04000     DATA PRESENT ?                  202
016F  C105 016C              BRCL  NE,KMR4           NO DATA, WAIT                   203
                                .                                                       204
0171  E107 8000    KMR5      LDR   I,KOR,08000       RESET CODE                      205
0173  D997                   ROUT  KOR,KOUT          RESET KEYBOARD                  206
0174  8CA8                   RIN   KIR,KIN           GET STATUS                      207
0175  9E08 2000              CMPL  I,KIR,02000       DATA STILL PRESENT ?            208
0177  C102 0171              BRCL  EQ,KMR5           KEEP TRYING TO CLEAR            209
                                .                                                       210
                                . *************                                       211
                                . DATA OBTAINED                                         212
                                . *************                                       213
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
                      .                                                               214
0179  A10E 007F              AND   I,KDATA,0007F      SAVE DATA ONLY                  215
                      .                                                               216
017B  208E                    CMP   IS,KDATA,008       COMPARE WITH BACKSPACE          217
017C  C105 0184               BRCL  NE,KMR6            NOT BACKSPACE                   218
017E  6FF5                    ADD   IS,KPC,-1          DECREMENT POINTER               219
017F  C105 0169               BRCL  NZ,KMR3            LOOK FOR DATA IF PC NOT ZERO    220
0181  4015                    LDR   IS,KPC,1           SET PC = 1                      221
0182  C107 0169               BRCL  U,KMR3             GET MORE DATA                   222
                      .                                                               223
0184  21CE            KMR6    CMP   IS,KDATA,01C       COMPARE WITH FORWARD SPACE      224
0185  C105 0190               BRCL  NE,KMR8            NOT FORWARD SPACE               225
0187  6015            KMR7    ADD   IS,KPC,1           INCREMENT POSITION COUNTER      226
0188  B105 0050               CMP   I,KPC,80           COMPARE WITH MAX VALUE          227
018A  C106 0169               BRCL  LE,KMR3            LESS OR EQUAL MAX, GET MORE DATA 228
018C  E105 0050               LDR   I,KPC,80           SET POSITION COUNTER TO 80      229
018E  C107 01B9               BRCL  U,KMR11            GET OUT OF ROUTINE              230
                      .                                                               231
0190  20DE            KMR8    CMP   IS,KDATA,00D       COMPARE WITH CARRIAGE RETURN    232
0191  C102 01B9               BRCL  EQ,KMR11           CR, GET OUT                     233
                      .                                                               234
0193  22EE                    CMP   IS,KDATA,02E       COMPARE WITH DECIMAL POINT      235
0194  C102 01B1               BRCL  EQ,KMR10           DECIMAL POINT, PUT IN BUFFER    236
                      .                                                               237
0196  220E                    CMP   IS,KDATA,020       COMPARE WITH SPACE              238
0197  C102 01B1               BRCL  EQ,KMR10           SPACE, PUT IN BUFFER            239
                      .                                                               240
0199  230E                    CMP   IS,KDATA,030       COMPARE WITH 0                  241
019A  C104 01AB               BRCL  LT,KMR9            ILLEGAL CHARACTER               242
                      .                                                               243
019C  239E                    CMP   IS,KDATA,039       COMPARE WITH 9                  244
019D  C106 01B1               BRCL  LE,KMR10           NUMERIC, PUT IN BUFFER          245
                      .                                                               246
019F  241E                    CMP   IS,KDATA,041       COMPARE WITH UPPER CASE A       247
01A0  C104 01AB               BRCL  LT,KMR9            ILLEGAL CHARACTER               248
                      .                                                               249
01A2  25AE                    CMP   IS,KDATA,05A       COMPARE WITH UPPER CASE Z       250
01A3  C106 01B1               BRCL  LE,KMR10           UPPER CASE ALPHA, PUT IN BUFFER 251
                      .                                                               252
01A5  261E                    CMP   IS,KDATA,061       COMPARE WITH LOWER CASE A       253
01A6  C104 01AB               BRCL  LT,KMR9            ILLEGAL CHARACTER               254
                      .                                                               255
01A8  27AE                    CMP   IS,KDATA,07A       COMPARE WITH LOWER CASE Z       256
01A9  C106 01B1               BRCL  LE,KMR10           LOWER CASE ALPHA, PUT IN BUFFER 257
                      .                                                               258
                      . **************                                              259
                      . ILLEGAL ENTRY                                                 260
                      . **************                                              261
                      .                                                               262
01AB  E101 022C   KMR9  LDR   I,KBUF,KBILL     GET ADDRESS OF ILLEGAL BUFFER   263
01AD  ED00 0230         BAL   I,KRET,OUTPUT      OUTPUT BUFFER                   264
01AF  C107 0153         BRCL  U,KMR1             START OVER                      265
                      .                                                               266
```

```
LOC   OBJECT CODE     CARD IMAGE                                                                    CARDNUM
                      . ****************************                                                    267
                      . VALID ENTRY - PUT IN BUFFER                                                 268
                      . ****************************                                                    269
                      .                                                                             270
01B1  9B5E 01D7       KMR10    STR    DX,KDATA,KBUFFER,KPC  PUT DATA IN BUFFER                      271
01E3  B056                     CMP    R,KPM,KPC             COMPARE MAX USED WITH LAST POSITIO       272
01B4  C103 0187                BRCL   GE,KMR7               GO INCREMENT POSITION COUNTER            273
01B6  E056                     LDR    R,KPM,KPC             PM = PC                                  274
01B7  C107 0187                BRCL   U,KMR7                KEEP GETTING DATA                        275
                      .                                                                             276
                      . ****                                                                        277
                      . EXIT                                                                        278
                      . ****                                                                        279
                      .                                                                             280
01B9  9C06 01D7       KMR11    STR    D,KPM,KBUFFER         PUT COUNT IN BUFFER                      281
                      .-------------------------------------------------------------------------    282
                      . THIS IS THE SEQUENCE FOR CALLING 'CORE' (UTILITY TO DISPLAY AND              283
                      . CHANGE CORE INTERACTIVELY). ALL CODE BETWEEN DOTTED LINES MAY BE            284
                      . REMOVED WHEN A CALL TO THAT PROGRAM IS NO LONGER DESIRED.                   285
01EB  E01B                     LDR    R,KV1,KBUF                                                   286
01BC  4005                     LDR    IS,KPC,0                                                     287
01BD  601B            KMR30    ADD    IS,KV1,1                                                     288
01BE  55BC                     LDR    RX,KV2,KV1,KPC                                               289
01BF  6FF6                     ADD    IS,KPM,-1                                                    290
01C0  C106 01D3                BRCL   NP,KMR12                                                     291
01C2  220C                     CMP    IS,KV2,020                                                   292
01C3  C102 01BD                BRCL   EQ,KMR30                                                     293
01C5  601B                     ADD    IS,KV1,1                                                     294
01C6  AE7C                     SHS    LL,KV2,8                                                     295
01C7  55BD                     LDR    RX,KV3,KV1,KPC                                               296
01C8  AE7D                     SHS    LL,KV3,8                                                     297
01C9  AD7D                     SHS    RL,KV3,8                                                     298
01CA  80DC                     ADD    R,KV2,KV3                                                    299
01CB  B10C 636F                CMP    I,KV2,0636F                                                  300
01CD  C105 01D3                BRCL   NE,KMR12                                                     301
01CF  E202 01D6                LDR    D,2,RETURN            GET ADDRESS OF CALLING ROUTINE         302
01D1  C107 02F8                BRC    I,7,CORE              GO PROCESS CORE REQUEST                303
                      .-------------------------------------------------------------------------    304
01D3  E200 01D6       KMR12    LDR    D,KRET,RETURN         RESTORE RETURN ADDRESS                 305
01D5  BF07                     BRC    R,7,KRET              RETURN                                 306
                      .                                                                             307
                      .                                                                             308
                      .                                                                             309
                      .                                                                             310
                      .                                                                             311
                      . ****                                                                        312
                      . DATA                                                                        313
                      . ****                                                                        314
                      .                                                                             315
                      .                                                                             316
01D6                  RETURN   DS     1                     RETURN ADDRESS STORAGE                 317
                      .                                                                             318
                      . **********************                                                      319
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
                    . KEYBOARD ENTRY BUFFER                                           320
                    . **********************                                        321
                    .                                                                 322
01D7  0050          KBUFFER  DC    80                 COUNT                         323
01D8                         DS    80                 RESERVE                       324
                    .                                                                 325
                    . ********************                                          326
                    . START SYMBOL BUFFER                                           327
                    . ********************                                          328
                    .                                                                 329
0228  0003          KBSTRT   DC    3                  COUNT                         330
0229  0D0A                   DC    0D0A               CR/LF                         331
022A  002B                   DC    002B               +                             332
022B  0000                   DC    00000              NULL                          333
                    .                                                                 334
                    . ************************                                      335
                    . ILLEGAL CHARACTER BUFFER                                      336
                    . ************************                                      337
                    .                                                                 338
022C  0003          KBILL    DC    3                  COUNT                         339
022D  0A07                   DC    0A07               CR,BELL                       340
022E  0707                   DC    0707               BELL,BELL                     341
022F  0000                   DC    00000              NULL                          342
                    .                                                                 343
                    .                                                                 344
                    .                                                                 345
                    .                                                                 346
                    . ***************************************************************347
                    . OUTPUT                                                        *348
                    .                                                               *349
                    . ROUTINE TO OUTPUT TO THE TTY/CRT                              *350
                    .                                                               *351
                    . CALLING PROCEDURE:                                            *352
                    .         BAL   I,0,OUTPUT                                      *353
                    .                                                               *354
                    . INPUTS:                                                       *355
                    .     REG 1     ADDRESS OF BUFFER TO BE OUTPUT                  *356
                    .                                                               *357
                    . THE BUFFER MUST BE SET UP IN THE FOLLOWING MANNER:            *358
                    .     WORD 1    N = NUMBER OF WORDS IN BUFFER TO BE OUTPUT     *359
                    .     WORDS 2-N ASCII DATA TO BE OUTPUT, TWO ASCII            *360
                    .               CHARACTERS PER WORD                             *361
                    .                                                               *362
                    . OUTPUTS:                                                      *363
                    .     NONE                                                      *364
                    .                                                               *365
                    . ROUTINES CALLED:                                              *366
                    .     NONE                                                      *367
                    .                                                               *368
                    . THIS ROUTINE PRESERVES NO REGISTERS                           *369
                    . ***************************************************************370
                    .                                                                 371
                    .                                                                 372
```

```
LOC   OBJECT CODE     CARD IMAGE                                                                                    CARDNUM
                      . ******************                                                                            373
                      . ESTABLISH EQUATES                                                                           374
                      . ******************                                                                            375
                      .                                                                                             376
                      BUFAD     EQU   1              ADDRESS OF BUFFER TO OUTPUT                                    377
                      BO        EQU   5              OUTPUT BUFFER ADDRESS                                          378
                      VIN       EQU   6              INPUT DEVICE ADDRESS                                           379
                      VOUT      EQU   7              OUTPUT DEVICE ADDRESS                                          380
                      VL        EQU   8              INPUT BUFFER LOWER BYTE                                        381
                      VU        EQU   9              INPUT BUFFER UPPER BYTE                                        382
                      WO        EQU   10             NUMBER OF WORDS TO OUTPUT                                      383
                      WI        EQU   11             NUMBER OF WORDS TO INPUT                                       384
                      VIU       EQU   12             UPPER BYTE INDEX                                               385
                      VIL       EQU   13             LOWER BYTE INDEX                                               386
                      STAT      EQU   14             STATUS                                                         387
                      WOUT      EQU   15             WORD TO OUTPUT TO TTY                                          388
                      .                                                                                             389
                      .                                                                                             390
                      .                                                                                             391
                      .                                                                                             392
                      . *******************************                                                               393
                      . INITIALIZE AND SET UP CONSTANTS                                                             394
                      . *******************************                                                               395
                      .                                                                                             396
0230  400C            OUTPUT    LDR   IS,VIU,0       INDEX FOR STORING UPPER BYTE                                   397
0231  401D                      LDR   IS,VIL,1       INDEX FOR STORING LOWER BYTE                                   398
0232  E106  FFBF                LDR   I,VIN,0FFBF    INPUT DEVICE ADDRESS                                           399
0234  E107  BFFF                LDR   I,VOUT,0BFFF   OUTPUT DEVICE ADDRESS                                          400
0236  51CB                      LDR   RX,WI,VIU,BUFAD GET INPUT WORD COUNT                                          401
0237  9C0C  026A      OUT5      STR   D,VIU,COUNT    INITIALIZE COUNT                                               402
0239  200B                      CMP   IS,WI,0        COMPARE WORD COUNT WITH ZERO                                   403
023A  C106  0269                BRCL  LE,OUT4        GET OUT IF COUNT LESS THAN ZERO                                404
023C  228B                      CMP   IS,WI,40       COMPARE WITH MAX VALUE                                         405
023D  C106  0242                BRCL  LE,OUT3        IF IN LIMIT KEEP GOING                                         406
023F  9C0B  026A                STR   D,WI,COUNT     SAVE ORIGINAL COUNT                                            407
0241  428B                      LDR   IS,WI,40       ONLY OUTPUT 40 WORDS                                           408
0242  E0BA            OUT3      LDR   R,WO,WI        PUT IN OUTPUT WORD COUNT                                       409
0243  AE0A                      SHS   LL,WO,1        DOUBLE FOR OUTPUT WORD COUNT                                   410
0244  E105  026B                LDR   I,BO,BUFOUT    GET OUTPUT BUFFER ADDRESS                                      411
                      .                                                                                             412
                      . *********************************************                                                 413
                      . TRANSFER INPUT BYTE BUFFER TO OUTPUT WORD BUFFER                                            414
                      . *********************************************                                                 415
                      .                                                                                             416
0246  6011            OUT1      ADD   IS,BUFAD,1     INCREMENT INPUT POINTER TO NEXT ENTR                           417
0247  51C9                      LDR   RX,VU,VIU,BUFAD GET INPUT WORD IN UPPER BYTE REGISTE                          418
0248  E098                      LDR   R,VL,VU        PUT IN LOWER BYTE REGISTER ALSO                                419
0249  AE78                      SHS   LL,VL,8        CLEAR UPPER BYTE                                               420
024A  AD78                      SHS   RL,VL,8        RIGHT JUSTIFY LOWER BYTE                                       421
024B  AD79                      SHS   RL,VU,8        RIGHT JUSTIFY UPPER BYTE                                       422
024C  15C9                      STR   RX,VU,VIU,BO   STORE UPPER BYTE AS FULL WORD                                  423
                      .                              IN THE OUTPUT BUFFER                                           424
024D  15D8                      STR   RX,VL,VIL,BO   STORE LOWER BYTE AS FULL WORD                                  425
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
                      .                                  IN THE OUTPUT BUFFER          426
024E  6025            .        ADD   IS,BO,2             INCREMENT OUTPUT BUFFER POINTER 427
024F  6FFB            .        ADD   IS,WI,-1            DECREMENT NUMBER OF WORDS TO INPUT 428
0250  C101 0246       .        BRCL  GT,OUT1             DO AGAIN IF NOT FINISHED      429
                      .                                                              430
                      . ******************                                           431
                      . OUTPUT WORD BUFFER                                           432
                      . ******************                                           433
                      .                                                              434
0252  E105 026B       .        LDR   I,BO,BUFOUT         GET ADDRESS OF OUTPUT BUFFER  435
0254  8C6E            . OUT2   RIN   STAT,VIN            GET STATUS                    436
0255  9E0E 1000       .        CMPL  I,STAT,01000        COMPARE STATUS                437
0257  C105 0254       .        BRCL  NE,OUT2             WAIT IF NOT READY             438
0259  B75F 0000       .        LLC   DX,WOUT,0,BO        GET CHARACTER TO OUTPUT       439
025B  A10F 01FF       .        AND   I,WOUT,01FF         CLEAR ALL BUT OUTPUT DATA     440
025D  D97F            .        ROUT  WOUT,VOUT           OUTPUT A CHARACTER            441
025E  6015            .        ADD   IS,BO,1             INCREMENT BUFFER POINTER      442
025F  6FFA            .        ADD   IS,WO,-1            DECREMENT WORD COUNTER        443
0260  C101 0254       .        BRCL  GT,OUT2             GO OUTPUT ANOTHER CHARACTER   444
                      .                                                              445
                      . ****                                                         446
                      . EXIT                                                         447
                      . ****                                                         448
                      .                                                              449
0262  F20B 026A       .        LDR   D,WI,COUNT          GET EXCESS COUNT              450
0264  C102 0269       .        BRCL  Z,OUT4              GET OUT IF ZERO               451
0266  6D8B            .        ADD   IS,WI,-40           DECREMENT BY 40               452
0267  C107 0237       .        BRCL  U,OUT5              DO AGAIN                      453
0269  BF07            . OUT4   BRC   R,7,RET                                         454
                      .                                                              455
                      . ****                                                         456
                      . DATA                                                         457
                      . ****                                                         458
                      .                                                              459
026A                  . COUNT  DS    1                  SAVE LOCATION FOR EXCESS COUNT 460
                      .                                                              461
026B                  . BUFOUT DS    80                 OUTPUT BUFFER                 462
                      .                                                              463
                      .                                                              464
                      .                                                              465
                      .                                                              466
                      . ************************************************************ 467
                      . HEXA                                                       * 468
                      .                                                            * 469
                      . ROUTINE TO CONVERT HEX TO ASCII                            * 470
                      .                                                            * 471
                      . CALLING PROCEDURE:                                         * 472
                      .         BAL   I,0,HEXA                                     * 473
                      .                                                            * 474
                      . INPUTS:                                                    * 475
                      .     REG 1     HEX VALUE TO BE CONVERTED (INTEGER)          * 476
                      .                                                            * 477
                      . OUTPUTS:                                                   * 478
```

```
LOC   OBJECT CODE     CARD IMAGE                                                                  CARDNUM
                      .     REG 2     MOST SIGNIFICANT TWO DIGITS IN ASCII        *                 479
                      .     REG 3     LEAST SIGNIFICANT TWO DIGITS IN ASCII       *                 480
                      .     LETTERS ARE OUTPUT IN UPPER CASE                      *                 481
                      .                                                           *                 482
                      . ROUTINES CALLED:                                          *                 483
                      .     NONE                                                  *                 484
                      .                                                           *                 485
                      . THIS ROUTINE DOES NOT DISTURB REGISTERS 5 THROUGH 15     *                 486
                      . ***********************************************************                 487
                      .                                                                           488
                      .                                                                           489
                      . ******************                                                        490
                      . ESTABLISH EQUATES                                                         491
                      . ******************                                                        492
                      .                                                                           493
                      HIN       EQU   1                 HEX VALUE INPUT                         494
                      MSD       EQU   2                 MOST SIGNIFICANT DIGITS TO OUTPUT       495
                      LSD       EQU   3                 LEAST SIGNIFICANT DIGITS TO OUTPUT      496
                      V1        EQU   4                 VARIABLE                                497
                      .                                                                           498
                      .                                                                           499
                      .                                                                           500
                      .                                                                           501
                      . *****************                                                       502
                      . CONVERT TO ASCII                                                          503
                      . *****************                                                       504
                      .                                                                           505
02BB  9C00 02E1       HEXA      STR   D,RET,HEXRTN      SAVE RETURN REGISTER                    506
02BD  E014                      LDR   R,V1,HIN          GET HEX INPUT VALUE                     507
02BE  AD84                      SHS   RL,V1,12          RIGHT JUSTIFY FIRST DIGIT               508
02BF  ED00 02DB                 BAL   I,RET,HEXA1       CONVERT FIRST DIGIT                     509
02C1  AE74                      SHS   LL,V1,8           POSITION DIGIT                          510
02C2  E042                      LDR   R,MSD,V1          PUT IN OUTPUT REGISTER                  511
02C3  E014                      LDR   R,V1,HIN          GET HEX INPUT VALUE                     512
02C4  AD74                      SHS   RL,V1,8           RIGHT JUSTIFY SECOND DIGIT              513
02C5  A104 000F                 AND   I,V1,0000F        CLEAR ALL BUT SECOND DIGIT              514
02C7  ED00 02DB                 BAL   I,RET,HEXA1       CONVERT SECOND DIGIT                    515
02C9  8042                      ADD   R,MSD,V1          PUT IN OUTPUT REGISTER                  516
02CA  E014                      LDR   R,V1,HIN          GET HEX INPUT VALUE                     517
02CB  A104 00F0                 AND   I,V1,000F0        CLEAR ALL BUT THIRD DIGIT               518
02CD  AD34                      SHS   RL,V1,4           RIGHT JUSTIFY THIRD DIGIT               519
02CE  ED00 02DB                 BAL   I,RET,HEXA1       CONVERT THIRD DIGIT                     520
02D0  AE74                      SHS   LL,V1,8           POSITION DIGIT                          521
02D1  E043                      LDR   R,LSD,V1          PUT IN OUTPUT REGISTER                  522
02D2  E014                      LDR   R,V1,HIN          GET HEX INPUT VALUE                     523
02D3  A104 000F                 AND   I,V1,0F           CLEAR ALL BUT FOURTH DIGIT              524
02D5  ED00 02DB                 BAL   I,RET,HEXA1       CONVERT FOURTH DIGIT                    525
02D7  8043                      ADD   R,LSD,V1          PUT IN OUTPUT REGISTER                  526
                      .                                                                           527
                      . ****                                                                      528
                      . EXIT                                                                      529
                      . ****                                                                      530
                      .                                                                           531
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
02D8  E200 02E1             LDR   D,RET,HEXRTN      GET RETURN ADDRESS                532
02DA  BF07                  BRC   R,7,RET          RETURN                            533
                                                                                      534
                    .*****************                                               535
                    . CONVERT ONE DIGIT                                               536
                    .*****************                                               537
                    .                                                                 538
02DB  20A4          HEXA1   CMP   IS,V1,00A        COMPARE WITH HEX 'A'              539
02DC  C104 02DF             BRCL  LT,HEXA2         BRANCH IF LESS                    540
02DE  6074                  ADD   IS,V1,7          ADD 7 TO VALUE                    541
02DF  6304          HEXA2   ADD   IS,V1,030        ADD HEX '30'                      542
02E0  BF07                  BRC   R,7,RET          GO BACK TO WHERE CALLED FROM      543
                    .                                                                 544
                    . ****                                                            545
                    . DATA                                                            546
                    . ****                                                            547
                    .                                                                 548
02E1                HEXRTN  DS    1                SAVE LOCATION FOR RETURN ADDRESS  549
                    .                                                                 550
                    .                                                                 551
                    .                                                                 552
                    .                                                                 553
                    .*****************************************************************554
                    . AHEX                                                           *555
                    .                                                                *556
                    . ROUTINE TO CONVERT FOUR (4) OR LESS DIGITS IN ASCII            *557
                    . CODE TO A TRUE HEX VALUE FOR THE MACHINE.  SIGN OF THE         *558
                    . VALUE MUST BE HANDLED BY THE CALLING ROUTINE.                  *559
                    .                                                                *560
                    . CALLING PROCEDURE:                                             *561
                    .         BAL   I,0,AHEX                                         *562
                    .                                                                *563
                    . INPUTS:                                                        *564
                    .     REG 1     ADDRESS OF FIRST CONSECUTIVE LOCATION IN         *565
                    .               CORE WHERE THE ASCII CHARACTERS ARE LOCATED      *566
                    .               (ONE CHARACTER PER CORE LOCATION)                *567
                    .                                                                *568
                    . OUTPUT:                                                        *569
                    .     REG 2     HEX VALUE                                      *570
                    .                                                                *571
                    . ROUTINES CALLED:                                               *572
                    .     NONE                                                       *573
                    .                                                                *574
                    . REGISTERS 8 THROUGH 16 ARE PRESERVED                           *575
                    .*****************************************************************576
                    .                                                                 577
                    . *****************                                               578
                    . ESTABLISH EQUATES                                               579
                    . *****************                                               580
                    .                                                                 581
                    AHADD   EQU   1                ADDRESS OF ASCII CHARACTERS       582
                    AHOUT   EQU   2                OUTPUT HEX VALUE                  583
                    AHV1    EQU   5                VARIABLE 1                        584
```

```
LOC   OBJECT CODE     CARD IMAGE                                                                    CARDNUM
                      AHV2      EQU   6                 VARIABLE 2                                      585
                      AHZ       EQU   7                 ZERO                                            586
                      .                                                                                 587
                      .                                                                                 588
                      .                                                                                 589
                      .                                                                                 590
                      . ********************                                                          591
                      . CONVERT ASCII TO HEX                                                            592
                      . ********************                                                          593
                      .                                                                                 594
02E2  4002            AHEX      LDR   IS,AHOUT,0        CLEAR REGISTER                                  595
02E3  4045                      LDR   IS,AHV1,4         SET UP COUNTER                                  596
02E4  4007                      LDR   IS,AHZ,0          SET UP ZERO REGISTER                            597
02E5  5176            AH1       LDR   RX,AHV2,AHZ,AHADD GET ASCII CHARACTER                             598
02E6  2206                      CMP   IS,AHV2,020       COMPARE WITH SPACE                              599
02E7  C102 02F7                 BRCL  EQ,AH3            DON'T TRANSLATE SPACES                          600
02E9  AE32                      SHS   LL,AHOUT,4        MOVE DIGIT OVER                                 601
02EA  2406                      CMP   IS,AHV2,040       COMPARE WITH MIN LETTER                         602
02EB  C104 02EE                 BRCL  LT,AH2            SKIP IF NUMERIC                                 603
02ED  6096                      ADD   IS,AHV2,9         INCREMENT ALPHA                                 604
02EE  A106 000F   AH2           AND   I,AHV2,0000F      CLEAR ALL BUT DIGIT                             605
02F0  8062                      ADD   R,AHOUT,AHV2      PUT IN OUTPUT REGISTER                          606
02F1  6FF5                      ADD   IS,AHV1,-1        DECREMENT COUNTER                               607
02F2  C102 02F7                 BRCL  Z,AH3             DONE                                            608
02F4  6011                      ADD   IS,AHADD,1        INCREMENT CHARACTER ADDRESS                     609
02F5  C107 02E5                 BRCL  U,AH1             KEEP GOING                                      610
02F7  BF07            AH3       BRC   R,7,RET           GET OUT                                         611
                      .                                                                                 612
                      .                                                                                 613
                      .                                                                                 614
                      .                                                                                 615
                      .*****************************************************************              616
                      . CORE                                                          *                 617
                      .                                                               *                 618
                      . ROUTINE TO CONTROL CORE INTERACTIVELY FROM THE KEYBOARD.      *                 619
                      .                                                               *                 620
                      .                                                               *                 621
                      . *****WARNING*****                                            *                 622
                      . THIS ROUTINE SHOULD ONLY BE CALLED BY 'KEYMR'. THERE ARE      *                 623
                      . SPECIAL CONSIDERATIONS IN CALLING WHICH ARE TAKEN INTO        *                 624
                      . ACCOUNT BY KEYMR. (TAKE SPECIAL NOTE OF REGISTER 2 WHEN       *                 625
                      . 'CORE' IS CALLED AND THE WAY 'CORE' EXITS THROUGH 'KEYMR'     *                 626
                      .                                                               *                 627
                      .                                                               *                 628
                      . MAY BE INITIATED BY THE OPERATOR AT ANY TIME WHEN THE         *                 629
                      . KEYBOARD IS ACCEPTING DATA BY TYPING 'CORE'.   ONCE           *                 630
                      . ENTERED, IT REMAINS IN CONTROL UNTIL RELEASED BY THE          *                 631
                      . TYPED COMMAND 'DONE'. THE COMMANDS AND FUNCTIONS ARE          *                 632
                      . AS LISTED:                                                    *                 633
                      .                                                               *                 634
                      .     COMMAND                 FUNCTION                          *                 635
                      .                                                               *                 636
                      .     DUMP 'ADD'              PRINTS 10 LINES OF 8 VALUES       *                 637
```

```
LOC   OBJECT CODE     CARD IMAGE                                                              CARDNUM
                  .                         OF CORE STARTING WITH THE      *                    638
                  .                         ADDRESS SPECIFIED . 'ADD'      *                    639
                  .                         MUST BE HEXIDECIMAL - ALPHA    *                    640
                  .                         CHARACTERS IN UPPER CASE.      *                    641
                  .                         'DUMP' MUST BE TYPED IN LOWER  *                    642
                  .                         CASE LETTERS                   *                    643
                  .                                                        *                    644
                  .    CHANGE 'ADD' 'VALUE' CHANGES THE CONTENTS OF THE    *                    645
                  .                         CORE LOCATION WHOSE ADDRESS    *                    646
                  .                         IS SPECIFIED TO THE VALUE      *                    647
                  .                         SPECIFIED                      *                    648
                  .                                                        *                    649
                  .    DISPLAY 'ADD'        DISPLAYS THE CONTENTS OF THE   *                    650
                  .                         CORE LOCATION IN 'ADD'         *                    651
                  .                                                        *                    652
                  .    CS 'ADD'             INITIATES THE CHANGING OF CORE*                     653
                  .                         SEQUENTIALLY STARTING WITH THE*                     654
                  .                         SPECIFIED ADDRESS. AFTER THIS *                     655
                  .                         COMMAND, THE FIRST FOUR CHARA-*                     656
                  .                         CTERS TYPED ARE PLACED IN CORE*                     657
                  .                         AND THE ADDRESS INCREMENTED BY*                     658
                  .                         ONE.  THE CHANGE IS TERMINATED*                     659
                  .                         BY TYPING 'DONE'.(THIS TYPING *                     660
                  .                         OF 'DONE' DOES NOT CAUSE THE   *                    661
                  .                         CORE PROGRAM TO BE EXITED)     *                    662
                  .                                                        *                    663
                  .                                                        *                    664
                  . CALLING PROCEDURE:                                     *                    665
                  .        BAL    I,0,CORE                                 *                    666
                  .                                                        *                    667
                  . INPUTS:                                                *                    668
                  .     NONE                                               *                    669
                  .                                                        *                    670
                  . OUTPUTS:                                               *                    671
                  .     NONE                                               *                    672
                  .                                                        *                    673
                  . ROUTINES CALLED:                                       *                    674
                  .     KEYMR                                              *                    675
                  .     OUTPUT                                             *                    676
                  .     HEXA                                               *                    677
                  .     AHEX                                               *                    678
                  .                                                        *                    679
                  . THIS ROUTINE PRESERVES NO REGISTERS                    *                    680
                  .**********************************************************                   681
                  .                                                                             682
                  . ****************                                                            683
                  . ESTABLISH EQUATES                                                           684
                  . ****************                                                            685
                  .                                                                             686
                  CADD      EQU    1                  ADDRESS OF BUFFER RETURNED .              687
                  CHV       EQU    1                  HEX VALUE TO INPUT TO HEXA                688
                  CA1       EQU    2                  ASCII MSD RETURNED BY HEXA                689
                  CA2       EQU    3                  ASCII LSD RETURNED BY HEXA                690
```

```
LOC   OBJECT CODE     CARD IMAGE                                                        CARDNUM
                      CV3       EQU   5                 VARIABLE 3                        691
                      CMAX      EQU   6                 MAX NO. CHARACTERS INPUT BY KEYMR 692
                      CINDX     EQU   7                 PATH FLAG                         693
                      CFLG      EQU   8                 BLANK FLAG                        694
                      CF2       EQU   9                 FIELD2                            695
                      CZERO     EQU   10                CONSTANT 0                        696
                      CSPACE    EQU   11                ASCII CODE FOR SPACE              697
                      CV1       EQU   12                VARIABLE 1                        698
                      CV2       EQU   13                VARIABLE 2                        699
                      CMD       EQU   14                COMMAND                           700
                      CP1       EQU   15                FIELD 1                           701
                      .                                                                   702
                      .                                                                   703
                      .                                                                   704
                      .                                                                   705
                      . ******                                                            706
                      . SET UP                                                            707
                      . ******                                                            708
                      .                                                                   709
02F8  9C02 03D3       CORE      STR   D,2,CSAVE         SAVE REGISTER 2                   710
02FA  400C                      LDR   IS,CV1,0          GET A ZERO                        711
02FB  9C0C 0412                 STR   D,CV1,CSPLG       INITIALIZE SEQUENTIAL CHANGE FLAG 712
02FD  E101 0405       C1        LDR   I,CADD,CTITLE     GET BUFFER ADDRESS FOR TITLE      713
02FF  ED00 0230                 BAL   I,RET,OUTPUT      OUTPUT TITLE                      714
0301  ED00 0151                 BAL   I,RET,KEYMR       GET KEYBOARD COMMAND              715
0303  E10B 2020                 LDR   I,CSPACE,02020    SET UP SPACE CODE                 716
0305  400A                      LDR   IS,CZERO,0        SET UP ZERO CONSTANT              717
0306  400E                      LDR   IS,CMD,0          ZERO COMMAND REGISTER             718
0307  400F                      LDR   IS,CF1,0          ZERO FIELD 1                      719
0308  4009                      LDR   IS,CF2,0          ZERO FIELD 2                      720
0309  4008                      LDR   IS,CFLG,0         ZERO FLAG                         721
030A  4007                      LDR   IS,CINDX,0        ZERO PATH FLAG                    722
                      .                                                                   723
                      . ****************                                                  724
                      . TRANSLATE COMMAND                                                 725
                      . ****************                                                  726
                      .                                                                   727
030B  51A6                      LDR   RX,CMAX,CZERO,CADD GET NO. OF ENTRIES IN BUFFER     728
030C  4008            C2        LDR   IS,CFLG,0         SET FLAG FOR READY                729
030D  6011            C3        ADD   IS,CADD,1         INCREMENT BUFFER ADDRESS          730
030E  6FF6                      ADD   IS,CMAX,-1        DECREMENT CHARACTER COUNTER       731
030F  C106 0327                 BRCL  NP,C6A            DONE                              732
0311  51AC                      LDR   RX,CV1,CZERO,CADD GET A CHARACTER FROM THE BUFFER   733
0312  220C                      CMP   IS,CV1,020        COMPARE WITH SPACE                734
0313  C102 030C                 BRCL  EQ,C2             KEEP GOING IF SPACE               735
0315  2008                      CMP   IS,CFLG,0         SEE IF IN MIDDLE OF ENTRY         736
0316  C105 030D                 BRCL  NE,C3             IN ENTRY, KEEP LOOKING            737
                      .                                                                   738
0318  E370 031B                 LDR   DX,RET,CFLD,CINDX GET PROCESSING ADDRESS            739
031A  BF07                      BRC   R,7,RET           PROCESS ACCORDING TO FIELD FOUND  740
                      .                                                                   741
                      . BRANCH TABLE                                                      742
                      .                                                                   743
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
031B  031E            CFLD     DC    C4              COMMAND FIELD                    744
031C  0323                     DC    C5              FIELD 1                          745
031D  0326                     DC    C6              FIELD 2                          746
                               .                                                      747
                               .                                                      748
031E  E01E            C4       LDR   R,CMD,CADD      ADDRESS OF COMMAND               749
031F  6017            C7       ADD   IS,CINDX,1      INCREMENT PATH INDEX             750
0320  4FF8                     LDR   IS,CFLG,-1      SET FLAG FOR IN ENTRY            751
0321  C107 030D                BRCL  U,C3            KEEP GOING                       752
0323  E01F            C5       LDR   R,CF1,CADD      ADDRESS OF FIELD 1               753
0324  C107 031F                BRCL  U,C7            KEEP GOING                       754
0326  E019            C6       LDR   R,CF2,CADD      ADDRESS OF FIELD 2               755
                               .                                                      756
                               .                                                      757
0327  200F            C6A      CMP   IS,CF1,0        SEE IF FIELD 1 IS PRESENT        758
0328  C102 0335                BRCL  EQ,C8           GO PROCESS COMMAND ONLY          759
                               .                                                      760
                               . CONVERT FIELD 1 TO HEX                               761
                               .                                                      762
032A  E0F1                     LDR   R,CADD,CF1      PUT ADDRESS IN REGISTER          763
032B  ED00 02E2                BAL   I,RET,AHEX      CONVERT VALUE                    764
032D  E02F                     LDR   R,CF1,CA1       PUT HEX VALUE IN FIELD           765
                               .                                                      766
                               .                                                      767
032E  2009                     CMP   IS,CF2,0        SEE IF FIELD 2 IS PRESENT        768
032F  C102 0335                BRCL  EQ,C8           GO PROCESS COMMAND               769
                               .                                                      770
                               . CONVERT FIELD 2 TO HEX                               771
                               .                                                      772
0331  E091                     LDR   R,CADD,CF2      PUT ADDRESS IN REGISTER          773
0332  ED00 02E2                BAL   I,RET,AHEX      CONVERT VALUE                    774
0334  E029                     LDR   R,CF2,CA1       PUT HEX VALUE IN FIELD           775
                               .                                                      776
                               .                                                      777
                               . BRANCH TO PROCESS ON COMMAND                         778
                               .                                                      779
0335  5EAC            C8       LDR   RX,CV1,CZERO,CMD GET FIRST CHARACTER OF COMMAND  780
0336  601E                     ADD   IS,CMD,1        INCREMENT ADDRESS                781
0337  5EAD                     LDR   RX,CV2,CZERO,CMD GET SECOND CHARACTER OF COMMAND 782
0338  A10D 00FF                AND   I,CV2,000FF     CLEAR UPPER BITS                 783
033A  AE7C                     SHS   LL,CV1,8        LEFT JUSTIFY 1ST CHARACTER       784
033B  80DC                     ADD   R,CV1,CV2       PUT 1ST 2 CHARACTERS IN ONE WORD 785
                               .                                                      786
033C  B10C 646F                CMP   I,CV1,0646F     COMPARE WITH 'DO'                787
033E  C102 0352                BRCL  EQ,C9           GO PROCESS DONE                  788
                               .                                                      789
0340  B10C 6475                CMP   I,CV1,06475     COMPARE WITH 'DU'                790
0342  C102 0356                BRCL  EQ,C10          GO PROCESS DUMP                  791
                               .                                                      792
0344  B10C 6469                CMP   I,CV1,06469     COMPARE WITH 'DI'                793
0346  C102 0383                BRCL  EQ,C11          GO PROCESS DISPLAY               794
                               .                                                      795
0348  B10C 6368                CMP   I,CV1,06368     COMPARE WITH 'CH'                796
```

```
LOC   OBJECT CODE     CARD IMAGE                                                                CARDNUM
034A  C102 039C             BRCL  EQ,C12              GO PROCESS 'CHANGE'                          797
                                                                                                 798
034C  B10C 6373             CMP   I,CV1,06373         COMPARE WITH 'CS'                            799
034E  C102 03A0             BRCL  EQ,C20              GO PROCESS CHANGE SEQUENTIAL                 800
                                                                                                 801
0350  C107 02FD             BRCL  U,C1                INVALID COMMAND, GO TRY AGAIN                802
                                                                                                 803
                                                                                                 804
                                                                                                 805
                                                                                                 806
                          . ****                                                                 807
                          . DONE                                                                 808
                          . ****                                                                 809
                                                                                                 810
0352  E200 03D3   C9        LDR   D,0,CSAVE           GET ADDRESS OF CALLING ROUTINE               811
0354  C107 0151             BRC   I,7,KEYMR           EXIT THROUGH KEYMR                           812
                                                                                                 813
                                                                                                 814
                                                                                                 815
                                                                                                 816
                          . ****                                                                 817
                          . DUMP                                                                 818
                          . ****                                                                 819
                                                                                                 820
0356  A10F FFF8   C10       AND   I,CF1,0FFF8         CLEAR LAST THREE BITS                        821
0358  E0F5                  LDR   R,CV3,CF1           SET UP ADDRESS TO DUMP                       822
0359  40A7                  LDR   IS,CINDX,10         SET UP LINE COUNTER                          823
                                                                                                 824
                          . OUTPUT LINE OF CORE WITH ADDRESS OF FIRST VALUE                      825
                                                                                                 826
035A  E10C 03D5   C13       LDR   I,CV1,CBUFF         SET UP OUTPUT BUFFER ADDRESS                 827
035C  E0AD                  LDR   R,CV2,CZERO         SET UP ROW COUNTER                           828
035D  E051                  LDR   R,CADD,CV3          SET UP INPUT FOR HEXA                        829
035E  ED00 02BB             BAL   I,RET,HEXA          CONVERT ADDRESS TO ASCII                     830
0360  1AC2                  STR   RX,CA1,CV1,CZERO    PUT MSD OF ADD IN OUTPUT BUFFER              831
0361  601C                  ADD   IS,CV1,1            INCREMENT BUFFER ADDRESS                     832
0362  1AC3                  STR   RX,CA2,CV1,CZERO    PUT LSD OF ADD IN OUTPUT BUFFER              833
0363  601C                  ADD   IS,CV1,1            INCREMENT BUFFER ADDRESS                     834
0364  1ACB                  STR   RX,CSPACE,CV1,CZERO   PUT IN SPACES                              835
0365  601C        C14       ADD   IS,CV1,1            INCREMENT BUFFER ADDRESS                     836
0366  1ACB                  STR   RX,CSPACE,CV1,CZERO   PUT IN SPACES                              837
0367  601C                  ADD   IS,CV1,1            INCREMENT BUFFER ADDRESS                     838
0368  5A51                  LDR   RX,CADD,CV3,CZERO   GET VALUE TO CONVERT                         839
0369  6015                  ADD   IS,CV3,1            INCREMENT ADD OF VALUE TO OUTPUT             840
036A  ED00 02BB             BAL   I,RET,HEXA          CONVERT VALUE                                841
036C  1AC2                  STR   RX,CA1,CV1,CZERO    PUT MSD OF VALUE IN OUTPUT BUFFER            842
036D  601C                  ADD   IS,CV1,1            INCREMENT BUFFER ADDRESS                     843
036E  1AC3                  STR   RX,CA2,CV1,CZERO    PUT LSD OF VALUE IN OUTPUT BUFFER            844
036F  601D                  ADD   IS,CV2,1            INCREMENT ROW COUNTER                        845
0370  208D                  CMP   IS,CV2,8            COMPARE WITH LAST VALUE                      846
0371  C102 0375             BRCL  EQ,C15              BRANCH IF EQUAL                              847
0373  C107 0365             BRCL  U,C14               GO DO ANOTHER VALUE                          848
0375  E101 03D5   C15       LDR   I,CADD,CBUFF        GET BUFFER POINTER                           849
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
0377  6FF1                    ADD   IS,CADD,-1          DECREMENT BY ONE TO GET COUNT      850
0378  9CF0 03F1               STRM  D,0,CS1,16          SAVE REGISTERS                     851
037A  ED00 0230               BAL   I,RET,OUTPUT        OUTPUT ONE LINE                    852
037C  BCF0 03F1               LDRM  D,0,CS1,16          RESTORE REGISTERS                  853
037E  6FF7                    ADD   IS,CINDX,-1         DECREMENT LINE COUNTER             854
037F  C105 035A               BRCL  NZ,C13              DO ANOTHER LINE                    855
0381  C107 02FD               BRC   I,7,C1              WAIT FOR ANOTHER COMMAND           856
                                                                                         857
                                                                                         858
                                                                                         859
                                                                                         860
                      *******                                                            861
                      DISPLAY                                                            862
                      *******                                                            863
                                                                                         864
0383  E0F1            C11     LDR   R,CADD,CP1          GET ADD OF LOCATION TO DISPLAY     865
0384  ED00 02BB               BAL   I,RET,HEXA          CONVERT CORE CONTENTS TO ASCII     866
0386  9C02 040A               STR   D,CA1,CBUD1         PUT MSD IN OUTPUT BUFFER           867
0388  9C03 040B               STR   D,CA2,CBUD1+1       PUT LSD IN OUTPUT BUFFER           868
038A  E3F1 0000               LDR   DX,CADD,0,CF1       PUT CORE VALUE IN REGISTER         869
038C  ED00 02BB               BAL   I,RET,HEXA          CONVERT ADDRESS TO ASCII           870
038E  9C02 040D               STR   D,CA1,CBUD2         PUT MSD IN OUTPUT BUFFER           871
0390  9C03 040E               STR   D,CA2,CBUD2+1       PUT LSD IN OUTPUT BUFFER           872
0392  E101 0409               LDR   I,CADD,CBUD         PUT ADDRESS IN REGISTER            873
0394  ED00 0230               BAL   I,RET,OUTPUT        OUTPUT BUFFER TO CRT               874
0396  E20F 0412               LDR   D,CP1,CSFLG         GET FLAG FOR SEQUENTIAL CHANGE     875
0398  C105 03C5               BRCL  NZ,C23              GO BACK TO SEQUENTIAL IF FLAG SET  876
039A  C107 02FD               BRC   I,7,C1              GO AGAIN                           877
                                                                                         878
                                                                                         879
                                                                                         880
                                                                                         881
                      ******                                                             882
                      CHANGE                                                             883
                      ******                                                             884
                                                                                         885
039C  9BF9 0000   C12         STR   DX,CF2,0,CP1        CHANGE CORE CONTENTS               886
039E  C107 0383               BRC   I,7,C11             GO DISPLAY CORE CHANGE             887
                                                                                         888
                                                                                         889
                                                                                         890
                              PAGE                                                       891
```

```
LOC   OBJECT CODE     CARD IMAGE                                                                  CARDNUM
                      .                                                                           892
                      . ************************                                                  893
                      . CHANGE CORE SEQUENTIALLY                                                  894
                      . ************************                                                  895
                      .                                                                           896
03A0  9C0F 0410 C20   STR   D,CF1,CSTRT      SAVE START OF CORE CHANGE                          897
03A2  9C0F 0411       STR   D,CF1,CSTOR      SAVE ADDRESS AT WHICH TO STORE                     898
03A4  401C            LDR   IS,CV1,1         SET UP A CONSTANT 1                                899
03A5  9C0C 0412       STR   D,CV1,CSFLG      SET FLAG FOR SEQUENTIAL CHANGE                     900
03A7  ED00 0151 C21   BAL   I,RET,KEYMR      GET VALUE FOR CORE                                 901
03A9  400A            LDR   IS,CZERO,0       SET UP ZERO REGISTER                               902
03AA  6011            ADD   IS,CADD,1        INCREMENT BUFFER POINTER                           903
03AB  4015            LDR   IS,CV3,1         SET UP A CONSTANT 1                                904
03AC  51AC            LDR   RX,CV1,CZERO,CADD GET FIRST CHARACTER ENTERED                       905
03AD  515D            LDR   RX,CV2,CV3,CADD  GET SECOND CHARACTER ENTERED                       906
03AE  AE7C            SHS   LL,CV1,8         LEFT JUSTIFY FIRST CHARACTER                       907
03AF  AE7D            SHS   LL,CV2,8         CLEAR UPPER 8 BITS OF SECOND CHAR                  908
03B0  AD7D            SHS   RL,CV2,8         RIGHT JUSTIFY SECOND CHARACTER                     909
03B1  80DC            ADD   R,CV1,CV2        COMBINE BOTH CHARACTERS                            910
03B2  B10C 646F       CMP   I,CV1,0646F      COMPARE WITH 'DO'                                  911
03B4  C102 03C1       BRCL  EQ,C22           GET OUT IF DONE                                    912
03B6  ED00 02E2       BAL   I,RET,AHEX       CONVERT ENTRY TO HEX                               913
03B8  E20F 0411       LDR   D,CF1,CSTOR      GET ADDRESS FOR STORING                            914
03BA  9BF2 0000       STR   DX,CA1,0,CF1     PUT VALUE IN CORE                                  915
03BC  601F            ADD   IS,CF1,1         INCREMENT STORE ADDRESS                            916
03BD  9C0F 0411       STR   D,CF1,CSTOR      SAVE NEW STORE ADDRESS                             917
03BF  C107 03A7       BRCL  U,C21            GO GET ANOTHER ENTRY                               918
03C1  E20F 0410 C22   LDR   D,CF1,CSTRT      GET ADDRESS OF FIRST CORE CHANGED                  919
03C3  C107 0383       BRCL  U,C11            GO DISPLAY LOCATION                                920
03C5  E20C 0410 C23   LDR   D,CV1,CSTRT      GET ADDRESS DISPLAYED                              921
03C7  601C            ADD   IS,CV1,1         INCREMENT ADDRESS                                  922
03C8  9C0C 0410       STR   D,CV1,CSTRT      SAVE AS NEW DISPLAY ADDRESS                        923
03CA  B20C 0411       CMP   D,CV1,CSTOR      COMPARE WITH LAST ADDRESS+1                        924
03CC  C104 03C1       BRCL  LT,C22           DO AGAIN IF NOT FINISHED                           925
03CE  400C            LDR   IS,CV1,0         GET A ZERO                                         926
03CF  9C0C 0412       STR   D,CV1,CSFLG      CLEAR SEQUENTIAL FLAG                              927
03D1  C107 02FD       BRCL  U,C1             GO GET ANOTHER COMMAND                             928
                      .                                                                         929
                      .                                                                         930
                      .                                                                         931
                      .                                                                         932
                      . ****************                                                        933
                      . DATA AND BUFFERS                                                        934
                      . ****************                                                        935
                      .                                                                         936
03D3                  CSAVE DS    1          ADDRESS OF ROUTINE CALLING CORE                    937
                      .                                                                         938
                      .                                                                         939
03D4  001C            CBCNT DC    28         COUNT OF VALUES IN BUFFER TO OUTPUT                940
03D5                  CBUFF DS    27         OUTPUT BUFFER                                      941
03F0  0D0A            DC    0D0A             CR/LF                                              942
                      .                                                                         943
                      .                                                                         944
```

```
LOC   OBJECT CODE      CARD IMAGE                                                    CARDNUM
03F1                   CS1       DS    20          REG SAVE AREA FOR INTERNAL USE      945
                       .                                                             946
                       .                                                             947
0405  0003             CTITLE    DC    3           COUNT                               948
0406  0D0A                       DC    00D0A       CR/LF                               949
0407  434F                       DC    0434F       CO                                  950
0408  5245                       DC    05245       RE                                  951
                       .                                                             952
0409  0006             CBUD      DC    6           COUNT                               953
040A                   CBUD1     DS    2           2 LOCATIONS FOR ADDRESS             954
                       .                                                             955
040C  2020                       DC    02020       BLANKS                              956
040D                   CBUD2     DS    2           2 LOCATIONS FOR CONTENTS            957
040F  0D0A                       DC    00D0A       CR/LF                               958
                       .                                                             959
0410  0000             CSTRT     DC    0           START ADDRESS FOR SEQUENTIAL CORE   960
0411  0000             CSTOR     DC    0           CURRENT ADDRESS FOR STORING IN SEQ  961
0412  0000             CSFLG     DC    0           FLAG FOR SEQUENTIAL CHANGE          962
                       .                                                             963
                       .                                                             964
                       .                                                             965
                                 END                                                 966
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
                      IDT    ATAC                                                       1
0000                  DS     0500                                                       2
                      ENTRY  WJ                                                         3
                      .                                                                 4
                      RET    EQU    0                                                   5
                      OUTPUT EQU    00230                                               6
                      KEYMR  EQU    00151                                               7
                      .                                                                 8
                      .                                                                 9
                      . ******************                                           10
                      . ESTABLISH EQUATES                                             11
                      . ******************                                           12
                      .                                                                 13
                      WJXS   EQU    1          XAR START                              14
                      WJXE   EQU    2          XAR END                                15
                      WJX1   EQU    3          XAR 1                                  16
                      WJX2   EQU    4          XAR 2                                  17
                      WJX3   EQU    5          XAR 3                                  18
                      WJX4   EQU    6          XAR 4                                  19
                      WJD1   EQU    7          DATA 1                                 20
                      WJD2   EQU    8          DATA 2                                 21
                      WJD3   EQU    9          DATA 3                                 22
                      WJD4   EQU    10         DATA 4                                 23
                      WJXX   EQU    11         XAR FOR CHECK                          24
                      WJV1   EQU    1          VARIABLE 1                             25
                      WJV2   EQU    2          VARIABLE 2                             26
                      WJV3   EQU    3          VARIABLE 3                             27
                      WJV4   EQU    4          VARIABLE 4                             28
                      WJV5   EQU    5          VARIABLE 5                             29
                      WJV6   EQU    6          VARIABLE 6                             30
                      WJV7   EQU    7          VARIABLE 7                             31
                      WJV8   EQU    8          VARIABLE 8                             32
                      WJV9   EQU    9          VARIABLE 9                             33
                      WJV10  EQU    10         VARIABLE 10                            34
                      WJV11  EQU    11         VARIABLE 11                            35
                      WJLPC  EQU    15         WJS COUNTER                            36
                      .                                                                 37
                      .                                                                 38
                      .                                                                 39
                      .                                                                 40
                      . *****                                                         41
                      . ENTRY                                                         42
                      . *****                                                         43
                      .                                                                 44
0500  9C00 09AD       WJ     STR    D,RET,WJRET     SAVE RETURN ADDRESS                45
                      .                                                                 46
                      . ********************                                        47
                      . INITIALIZE RECEIVER                                           48
                      . ********************                                        49
                      .                                                                 50
0502  BC31 09BC       WJ01   LDRM   D,WJV1,WJI1,4   GET INITIAL CONTROL WORDS FOR RCVR  51
0504  9C31 09C8              STRM   D,WJV1,WJCW1,4  PUT INITIAL VALUES INTO CONTROL     52
0506  BC71 09C0              LDRM   D,WJV1,WJICD,8  GET INITIAL CONTROL WORD DISPLAY    53
0508  9C71 09D8              STRM   D,WJV1,WJCFL,8  SAVE INITIAL CONTROL WORD DISPLAY   54
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
050A  E603 09DB             LLC   D,WJX1,WJCRO        LOAD "ADDRESS ON"                55
050C  D932                  ROUT  02,WJX1             ENABLE RECEIVER/TURN ON INTERFACE 56
050D  E101 0000             LDR   I,WJXS,0            CLEAR REGISTER                   57
050F  9C01 09F4             STR   D,WJXS,CHKFLG1      CLEAR FLAG                       58
0511  9C01 09F6             STR   D,WJXS,WJLPK        ZERO WJS COUNTER                 59
0513  ED00 08AE             BAL   I,RET,WJS           SEND INITIAL CONTROL WORD TO RCVR 60
0515  E101 0A02             LDR   I,WJV1,WJINS        GET ADDRESS OF INSTRUCTION BUFFER 61
0517  ED00 0230             BAL   I,RET,OUTPUT        OUTPUT INSTRUCTIONS TO CRT       62
0519  E101 09F7  WJ02       LDR   I,WJV1,WJT          GET ADDRESS OF TITLE BUFFER      63
051B  ED00 07AE             BAL   I,RET,WJ90          OUTPUT TITLE AND GET ENTRY       64
051D  C107 0519             BRCL  U,WJ02              ILLEGAL ENTRY                    65
                                                                                       66
                      . *****************                                            67
                      . TRANSLATE COMMAND                                            68
                      . *****************                                            69
                      .                                                              70
051F  2012                  CMP   IS,WJV2,1           COMPARE WITH ONE                 71
0520  C105 0519             BRCL  NE,WJ02             WILL ONLY ACCEPT ONE CHAR        72
0522  2083                  CMP   IS,WJV3,8           COMPARE WITH MAX VALUE           73
0523  C101 0519             BRCL  GT,WJ02             ENTRY OUT OF RANGE               74
                                                                                       75
                      . ***************************                                    76
                      . BRANCH ACCORDING TO COMMAND                                  77
                      .***************************                                   78
                      .                                                              79
0525  E330 0528             LDR   DX,RET,WJBRC,WJV3   GET ADDRESS FOR BRANCH FROM TABLE 80
0527  BF07                  BRC   R,7,RET             GO PROCESS ACCORDING TO COMMAND  81
                      .                                                              82
                      . BRANCH TABLE FOR COMMANDS FROM OPERATOR                      83
                      .                                                              84
0528  0531  WJBRC    DC    WJ10                      0=SET UP TENTATIVE WORD          85
0529  05AE           DC    WJ20                      1=DISPLAY TENTATIVE CONTROL WORD 86
052A  05C6           DC    WJ30                      2=DISPLAY CONTROL WORD           87
052B  05DE           DC    WJ40                      3=DISPLAY LAST RECEIVED WORD     88
052C  0614           DC    WJ50                      4=ENTER TENTATIVE WORD AS NEW CONTRO 89
052D  0657           DC    WJ60                      5=SCAN                           90
052E  C790           DC    WJ70                      6=RECEIVE CONTROL WORD FROM RCVR 91
052F  C7A8           DC    WJ80                      7=DONE                           92
0530  C502           DC    WJ01                      8=REINITIALIZE                   93
                      .                                                              94
                      .                                                              95
                      .                                                              96
                      .                                                              97
                      . ******************                                           98
                      . SET UP (COMMAND=0)                                           99
                      . ******************                                          100
                      .                                                             101
                      . OUTPUT TITLE AND GET KEYBOARD ENTRY FOR FREQUENCY           102
                      .                                                             103
0531  E101 0A4B  WJ10       LDR   I,WJV1,WJFB         GET ADDRESS OF FREQUENCY TITLE 104
0533  ED00 07AE             BAL   I,RET,WJ90          OUTPUT TITLE AND GET ENTRY     105
0535  C107 0531             BRCL  U,WJ10              ILLEGAL ENTRY                  106
0537  ED00 07CC             BAL   I,RET,WJ91          MAKE SURE FREQUENCY IS LEGAL   107
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
0539  C107 0531             BRCL  U,WJ10          ILLEGAL FREQUENCY                    108
053B  9C03 09D0             STR   D,WJV3,WJTFL    STORE TENTATIVE FREQUENCY (LOWER)    109
053D  9C04 09D1             STR   D,WJV4,WJTFU    STORE TENTATIVE FREQUENCY (UPPER)    110
                                                                                       111
                      * OUTPUT TITLE AND GET KEYBOARD ENTRY FOR DETECT MODE            112
                      *                                                                113
053F  E101 0A89 WJ11  LDR   I,WJV1,WJDMB    GET ADDRESS OF DETECT MODE TITLE         114
0541  ED00 07AE        BAL   I,RET,WJ90      OUTPUT TITLE AND GET ENTRY               115
0543  C107 053F        BRCL  U,WJ11          ILLEGAL ENTRY                            116
0545  2073            CMP   IS,WJV3,7       COMPARE WITH MAX VALUE                   117
0546  C101 053F        BRCL  GT,WJ11         TOO LARGE                                118
0548  9C03 09D2        STR   D,WJV3,WJTDM    SAVE TENTATIVE DETECT MODE               119
054A  E101 0004        LDR   I,WJV1,04       GET UPPER OF DEFAULT BFO FREQUENCY       120
054C  9C01 09D4        STR   D,WJV1,WJTBU    SAVE TENTATIVE BFO FREQUENCY (UPPER)     121
054E  E101 5500        LDR   I,WJV1,05500    GET LOWER OF DEFAULT BFO FREQUENCY       122
0550  9C01 09D3        STR   D,WJV1,WJTBL    SAVE TENTATIVE BFO FREQUENCY (LOWER)     123
0552  2033            CMP   IS,WJV3,3       COMPARE DETECT MODE WITH BFO VARIABL     124
0553  C105 056E        BRCL  NE,WJ13         NOT VARIABLE BFO, USE DEFAULT FREQUE     125
                                                                                       126
                      * OUTPUT TITLE AND GET KEYBOARD ENTRY FOR BFO FREQUENCY          127
                      *                                                                128
0555  E101 0AB3 WJ12  LDR   I,WJV1,WJBFB    GET ADDRESS OF BFO FREQUENCY TITLE       129
0557  ED00 07AE        BAL   I,RET,WJ90      OUTPUT TITLE AND GET ENTRY               130
0559  C107 0555        BRCL  U,WJ12          ILLEGAL ENTRY                            131
055B  2062            CMP   IS,WJV2,6       COMPARE WITH EXACT COUNT                 132
055C  C105 0555        BRCL  NE,WJ12         WRONG COUNT                              133
055E  E833            SHD   RL,WJV3,4       POSITION FREQUENCY (10 HZ RES)           134
055F  2044            CMP   IS,WJV4,04      COMPARE UPPER WITH EXACT VALUE           135
0560  C105 0555        BRCL  NE,WJ12         ILLEGAL ENTRY                            136
0562  B103 4500        CMP   I,WJV3,04500    COMPARE LOWER WITH MIN VALUE             137
0564  C104 0555        BRCL  LT,WJ12         ILLEGAL ENTRY                            138
0566  B103 6500        CMP   I,WJV3,06500    COMPARE LOWER WITH MAX VALUE             139
0568  C101 0555        BRCL  GT,WJ12         ILLEGAL ENTRY                            140
056A  9C03 09D3        STR   D,WJV3,WJTBL    SAVE TENTATIVE BFO FREQUENCY (LOWER)     141
056C  9C04 09D4        STR   D,WJV4,WJTBU    SAVE TENTATIVE BFO FREQUENCY (UPPER)     142
                                                                                       143
                      * OUTPUT TITLE AND GET KEYBOARD ENTRY FOR GAIN MODE              144
                      *                                                                145
056E  E101 0A53 WJ13  LDR   I,WJV1,WJGMB    GET ADDRESS OF GAIN MODE TITLE           146
0570  ED00 07AE        BAL   I,RET,WJ90      OUTPUT TITLE AND GET ENTRY               147
0572  C107 056E        BRCL  U,WJ13          ILLEGAL ENTRY                            148
0574  2033            CMP   IS,WJV3,3       COMPARE WITH MAX VALUE                   149
0575  C101 056E        BRCL  GT,WJ13         ILLEGAL ENTRY                            150
0577  2013            CMP   IS,WJV3,1       COMPARE WITH ENTRY FO 1                  151
0578  C102 056E        BRCL  EQ,WJ13         ILLEGAL ENTRY                            152
057A  E201 09D2        LDR   D,WJV1,WJTDM    GET TENTATIVE DETECT MODE                153
057C  2041            CMP   IS,WJV1,4       COMPARE WITH ISE                         154
057D  C105 0582        BRCL  NE,WJ131        BRANCH IF NOT ISB                        155
057F  2003            CMP   IS,WJV3,0       MAKE SURE GAIN MODE NOT HOLD AGC         156
0580  C102 056E        BRCL  EQ,WJ13         ILLEGAL ENTRY                            157
0582  9C03 09D5 WJ131 STR   D,WJV3,WJTGM    SAVE TENTATIVE GAIN MODE                 158
                                                                                       159
                      * OUTPUT TITLE AND GET KEYBOARD ENTRY FOR IF BANDWIDTH           160
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
                      .                                                             161
0584  E201 09D2       .       LDR   D,WJV1,WJTDM      GET TENTATIVE DETECT MODE     162
0586  2041            .       CMP   IS,WJV1,4         COMPARE WITH ISE              163
0587  C104 058F       .       BRCL  LT,WJ14           NOT SIDEBAND-BRANCH           164
0589  2061            .       CMP   IS,WJV1,6         COMPARE WITH USB              165
058A  C101 058F       .       BRCL  GT,WJ14           NOT SIDEBAND-BRANCH           166
058C  4043            .       LDR   IS,WJV3,4         LOAD DEFAULT IF BANDWIDTH     167
058D  C107 059B       .       BRCL  U,WJ141           SKIP IF BANDWIDTH             168
058F  E101 0A6D  WJ14 .       LDR   I,WJV1,WJIFB      GET ADDRESS OF IF BANDWIDTH TITLE 169
0591  ED00 07AE       .       BAL   I,RET,WJ90        OUTPUT TITLE AND GET ENTRY    170
0593  C107 058F       .       BRCL  U,WJ14            ILLEGAL ENTRY                 171
0595  2043            .       CMP   IS,WJV3,4         COMPARE WITH MAX VALUE        172
0596  C101 058F       .       BRCL  GT,WJ14           ILLEGAL ENTRY                 173
0598  2013            .       CMP   IS,WJV3,1         COMPARE WITH MIN VALUE        174
0599  C104 058F       .       BRCL  LT,WJ14           ILLEGAL ENTRY                 175
059B  9C03 09D7  WJ141 .       STR   D,WJV3,WJTIF      SAVE TENTATIVE IF BANDWIDTH   176
                      .                                                             177
                      . OUTPUT TITLE AND GET KEYBOARD ENTRY FOR RF GAIN             178
                      .                                                             179
059D  E101 0ACA  WJ15 .       LDR   I,WJV1,WJRFGB     GET ADDRESS OF RF GAIN TITLE  180
059F  ED00 07AE       .       BAL   I,RET,WJ90        OUTPUT TITLE AND GET ENTRY    181
05A1  C107 059D       .       BRCL  U,WJ15            ILLEGAL ENTRY                 182
05A3  2032            .       CMP   IS,WJV2,3         COMPARE WITH MAX COUNT        183
05A4  C101 059D       .       BRCL  GT,WJ15           ILLEGAL ENTRY                 184
05A6  B103 0100       .       CMP   I,WJV3,0100       COMPARE WITH MAX VALUE        185
05A8  C101 059D       .       BRCL  GT,WJ15           ILLEGAL ENTRY                 186
05AA  9C03 09D6       .       STR   D,WJV3,WJTRFG     SAVE TENTATIVE RF GAIN        187
                      .                                                             188
05AC  C107 0519       .       BRCL  U,WJ02            GO GET ANOTHER COMMAND        189
                      .                                                             190
                      .                                                             191
                      .                                                             192
                      .                                                             193
                      . ****************************************                    194
                      . DISPLAY TENTATIVE CONTROL WORD (COMMAND=1)                  195
                      . ****************************************                    196
                      .                                                             197
05AE  E202 09D1  WJ20 .       LDR   D,WJV2,WJTFU      GET UPPER OF TENTATIVE FREQUENCY 198
05E0  E201 09D0       .       LDR   D,WJV1,WJTFL      GET LOWER OF TENTATIVE FREQUENCY 199
05E2  ED00 07D9       .       BAL   I,RET,WJ92        PUT FREQUENCY IN BUFFER AND DISPLAY 200
05E4  E201 09D5       .       LDR   D,WJV1,WJTGM      GET TENTATIVE GAIN MODE       201
05E6  E202 09D7       .       LDR   D,WJV2,WJTIF      GET TENTATIVE IF BANDWIDTH    202
05E8  ED00 0801       .       BAL   I,RET,WJ93        OUTPUT GAIN MODE AND IF BANDWIDTH 203
05EA  E201 09D2       .       LDR   D,WJV1,WJTDM      GET TENTATIVE DETECT MODE     204
05EC  E202 09D3       .       LDR   D,WJV2,WJTBL      GET TENTATIVE BFO FREQUENCY (LOWER) 205
05EE  ED00 0820       .       BAL   I,RET,WJ94        OUTPUT DETECT MODE AND BFO FREQUENCY 206
05C0  E201 09D6       .       LDR   D,WJV1,WJTRFG     GET TENTATIVE RF GAIN         207
05C2  ED00 084A       .       BAL   I,RET,WJ95        OUTPUT RF GAIN                208
05C4  C107 0519       .       BRCL  U,WJ02            DONE                          209
                      .                                                             210
                      .                                                             211
                      .                                                             212
                      .                                                             213
```

```
LOC   OBJECT CODE     CARD IMAGE                                                                                    CARDNUM
                      . ********************************                                                              214
                      . DISPLAY CONTROL WORD (COMMAND=2)                                                            215
                      . ********************************                                                              216
                      .                                                                                             217
05C6  E202 09D9   WJ30      LDR   D,WJV2,WJCFU        GET UPPER OF CONTROL FREQUENCY                              218
05C8  E201 09D8             LDR   D,WJV1,WJCFL        GET LOWER OF CONTROL FREQUENCY                              219
05CA  ED00 07D9             BAL   I,RET,WJ92          OUTPUT FREQUENCY                                            220
05CC  E201 09DD             LDR   D,WJV1,WJCGM        GET CONTROL GAIN MODE                                       221
05CE  E202 09DF             LDR   D,WJV2,WJCIF        GET CONTROL IF BANDWIDTH                                    222
05D0  ED00 0801             BAL   I,RET,WJ93          OUTPUT GAIN MODE AND IF BANDWIDTH                           223
05D2  E201 09DA             LDR   D,WJV1,WJCDM        GET CONTROL DETECT MODE                                     224
05D4  E202 09DB             LDR   D,WJV2,WJCBL        GET CONTROL BFO FREQUENCY (LOWER)                           225
05D6  ED00 0820             BAL   I,RET,WJ94          OUTPUT DETECT MODE AND BFO FREQUENCY                        226
05D8  E201 09DE             LDR   D,WJV1,WJCRFG       GET CONTROL RF GAIN                                         227
05DA  ED00 084A             BAL   I,RET,WJ95          OUTPUT RF GAIN                                              228
05DC  C107 0519             BRCL  U,WJ02              DONE                                                        229
                      .                                                                                             230
                      .                                                                                             231
                      .                                                                                             232
                      .                                                                                             233
                      . ********************************                                                              234
                      . DISPLAY RECEIVED WORD (COMMAND=3)                                                           235
                      . ********************************                                                              236
                      .                                                                                             237
05DE  E202 09E1   WJ40      LDR   D,WJV2,WJRFU        GET UPPER OF RECEIVED FREQUENCY                             238
05E0  E201 09E0             LDR   D,WJV1,WJRFL        GET LOWER OF RECEIVED FREQUENCY                             239
05E2  ED00 07D9             BAL   I,RET,WJ92          OUTPUT FREQUENCY                                            240
05E4  E201 09E5             LDR   D,WJV1,WJRGM        GET RECEIVED GAIN MODE                                      241
05E6  E202 09E7             LDR   D,WJV2,WJRIF        GET RECEIVED IF BANDWIDTH                                   242
05E8  ED00 0801             BAL   I,RET,WJ93          OUTPUT GAIN MODE AND IF BANDWIDTH                           243
05EA  E201 09E2             LDR   D,WJV1,WJRDM        GET RECEIVED DETECT MODE                                    244
05EC  E202 09E3             LDR   D,WJV2,WJRBL        GET RECEIVED BFO FREQUENCY (LOWER)                          245
05EE  ED00 0820             BAL   I,RET,WJ94          OUTPUT DETECT MODE AND BFO FREQUENCY                        246
05F0  E201 09E6             LDR   D,WJV1,WJRRFG       GET RECEIVED RF GAIN                                        247
05F2  ED00 084A             BAL   I,RET,WJ95          OUTPUT RF GAIN                                              248
05F4  E201 09E9             LDR   D,WJV1,WJRSS        GET RECEIVED SIGNAL STRENGTH                                249
05F6  4002                  LDR   IS,WJV2,0           CLEAR REGISTER                                              250
05F7  F871                  SHD   LL,WJV1,8           POSITION 1ST DIGIT                                          251
05F8  A502 2030             IOR   I,WJV2,02030        CONVERT TO ASCII                                            252
05FA  9C02 0B22             STR   D,WJV2,WJDSS1       STORE IN OUTPUT BUFFER                                      253
05FC  4002                  LDR   IS,WJV2,0           CLEAR REGISTER                                              254
05FD  F831                  SHD   LL,WJV1,4           POSITION LAST 2 DIGITS                                      255
05FE  AE32                  SHS   LL,WJV2,4                                                                       256
05FF  F831                  SHD   LL,WJV1,4                                                                       257
0600  A502 3030             IOR   I,WJV2,03030        CONVERT TO ASCII                                            258
0602  9C02 0B23             STR   D,WJV2,WJDSS1+1     STORE IN OUTPUT BUFFER                                      259
0604  E101 0B18             LDR   I,WJV1,WJDSS        GET ADDRESS OF BUFFER TO OUTPUT                             260
0606  ED00 0230             BAL   I,RET,OUTPUT        OUTPUT BUFFER                                               261
0608  C107 0519             BRCL  U,WJ02              DONE                                                        262
060A                        DS    10                  SPACE FOR PATCHES                                           263
                      .                                                                                             264
                      .                                                                                             265
                      .                                                                                             266
```

```
LOC   OBJECT CODE     CARD IMAGE                                                                  CARDNUM
                      .                                                                             267
                      . ****************************************                                    268
                      . ENTER TENTATIVE CONTROL WORD (COMMAND=4)                                    269
                      . ****************************************                                    270
                      .                                                                             271
0614  BC71 09D0  WJ50     LDRM  D,WJV1,WJTFL,8      GET TENTATIVE VALUES IN DISPLAY FORM          272
0616  9C71 09D8           STRM  D,WJV1,WJCFL,8      STORE IN CONTROL VALUES IN DISPLAY F          273
0618  F831                SHD   LL,WJV1,4           POSITION FREQUENCY                            274
0619  9C02 09C8           STR   D,WJV2,WJCW1        SET UP CONTROL WORD 1                         275
061B  AE16                SHS   LL,WJV6,2           POSITION GAIN MODE                            276
061C  A461                IOR   R,WJV1,WJV6         PUT IN CW 2                                   277
061D  E082                LDR   R,WJV2,WJV8         GET IF BANDWIDTH                              278
061E  AD02                SHS   RL,WJV2,1           POSITION BANDWIDTH                            279
061F  A421                IOR   R,WJV1,WJV2         PUT IN CW 2                                   280
0620  9C01 09C9           STR   D,WJV1,WJCW2        STORE CONTROL WORD 2                          281
0622  E081                LDR   R,WJV1,WJV8         GET IF BANDWIDTH                              282
0623  AEE1                SHS   LL,WJV1,15          POSITION LAST DIGIT OF BANDWIDTH              283
0624  AEB3                SHS   LL,WJV3,12          POSITION DETECT MODE                          284
0625  A431                IOR   R,WJV1,WJV3         PUT DETECT MODE IN CW 3                       285
0626  9C01 09CA           STR   D,WJV1,WJCW3        SAVE CW 3                                     286
0628  E042                LDR   R,WJV2,WJV4         GET BFO LOWER VALUE                           287
0629  ED00 098E           BAL   I,RET,WJBCDH        CONVERT BCD VALUE TO HEX                      288
062B  8501 1194           SUB   I,WJV1,4500         SUBTRACT 4500 FROM VALUE                      289
062D  CD01 07FF           MUL   I,WJV1,07FF         MULTIPLY BY 7FF                               290
062F  E103 07D0           LDR   I,WJV3,2000         SET UP DIVISOR                                291
0631  8101 0373           ADD   I,WJV1,0373         ROUND                                         292
0633  FC31                DIV   R,WJV1,WJV3         DIVIDE                                        293
0634  E023                LDR   R,WJV3,WJV2         REARRANGE  REGISTERS                          294
0635  E201 09CA  WJ503    LDR   D,WJV1,WJCW3        GET REST OF CW 3                              295
0637  A431                IOR   R,WJV1,WJV3         GET BFO FREQUENCY INTO CW 3                   296
0638  9C01 09CA           STR   D,WJV1,WJCW3        STORE CONTROL WORD 3                          297
063A  E202 09D6           LDR   D,WJV2,WJTRFG       GET RF GAIN VALUE                             298
063C  ED00 098E           BAL   I,RET,WJBCDH        CONVERT BCD TO HEX                            299
063E  CD01 007F           MUL   I,WJV1,07F          MULTIPLY BY 7F                                300
0640  6321                ADD   IS,WJV1,032         ROUND                                         301
0641  4643                LDR   IS,WJV3,064         SET UP DIVISOR                                302
0642  FC31                DIV   R,WJV1,WJV3         DIVIDE                                        303
0643  B421                LLC   R,WJV1,WJV2         GET VALUE COMPLEMENTED FOR WJ                 304
0644  A101 007F           AND   I,WJV1,07F          CLEAR ALL BUT VALUE WANTED                    305
0646  AE71                SHS   LL,WJV1,8           POSITION RF GAIN                              306
0647  9C01 09CB           STR   D,WJV1,WJCW4        STORE CONTROL WORD 4                          307
0649  ED00 08AE           BAL   I,RET,WJS           OUTPUT CONTROL WORD TO WJ                     308
064B  C107 0519           BRCL  U,WJ02              DONE                                          309
064D                      DS    10                  SPACE FOR PATCHES                             310
                      .                                                                           311
                      .                                                                           312
                      .                                                                           313
                      .                                                                           314
                      . ****************                                                          315
                      . SCAN (COMMAND=5)                                                          316
                      . ****************                                                          317
                      .                                                                           318
0657  4001        WJ60    LDR   IS,WJV1,0           CLEAR REGISTER                              319
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
0658  9C01 09F0             STR   D,WJV1,WJSCNT       INITIALIZE PASS COUNT          320
065A  E101 0B97             LDR   I,WJV1,WJSCAN       GET ADDRESS OF SCAN TITLE      321
065C  ED00 0230             BAL   I,RET,OUTPUT        OUTPUT SCAN TITLE              322
065E                        DS    10                  SPACE FOR PATCHES              323
                                                                                     324
                     : OUTPUT TITLE AND GET LOWER FREQUENCY LIMIT                    325
                     .                                                              326
0668  E101 0B9C    WJ601  LDR   I,WJV1,WJSFS        GET ADDRESS OF START FREQUENCY TITLE 327
066A  ED00 07AE             BAL   I,RET,WJ90          OUTPUT TITLE AND GET ENTRY     328
066C  C107 0668             BRCL  U,WJ601             ILLEGAL ENTRY                  329
066E  ED00 07CC             BAL   I,RET,WJ91          MAKE SURE FREQ IS IN LEGAL BOUNDS 330
0670  C107 0668             BRCL  U,WJ601             ILLEGAL ENTRY                  331
0672  9C03 09ED             STR   D,WJV3,WJSFLL       SAVE LOWER LIMIT (LOWER)       332
0674  9C04 09EC             STR   D,WJV4,WJSFLU       SAVE LOWER LIMIT (UPPER)       333
0676                        DS    10                  SPACE FOR PATCHES              334
                     .                                                              335
                     : OUTPUT TITLE AND GET UPPER FREQUENCY LIMIT                    336
                     .                                                              337
0680  E101 0BA7    WJ602  LDR   I,WJV1,WJSFE        GET ADDRESS OF END FREQ TITLE  338
0682  ED00 07AE             BAL   I,RET,WJ90          OUTPUT TITLE AND GET ENTRY     339
0684  C107 0680             BRCL  U,WJ602             ILLEGAL ENTRY                  340
0686  ED00 07CC             BAL   I,RET,WJ91          MAKE SURE FREQ IS IN LEGAL BOUNDS 341
0688  C107 0680             BRCL  U,WJ602             ILLEGAL ENTRY                  342
068A  9C03 09EB             STR   D,WJV3,WJSFUL       SAVE UPPER LIMIT (LOWER)       343
068C  9C04 09EA             STR   D,WJV4,WJSFUU       SAVE UPPER LIMIT (UPPER)       344
068E                        DS    10                  SPACE FOR PATCHES              345
                     .                                                              346
                     : MAKE SURE UPPER LIMIT GREATER THAN LOWER LIMIT                347
                     .                                                              348
0698  E205 09EC             LDR   D,WJV5,WJSFLU       GET LOWER LIMIT (UPPER)        349
069A  B054                  CMP   R,WJV4,WJV5         COMPARE UPPER AND LOWER LIMITS' (UPPE 350
069B  C104 0668             BRCL  LT,WJ601            UPPER LIMIT LESS THAN LOWER    351
069D  C101 06AE             BRCL  GT,WJ603            NO NEED TO CHECK FURTHER       352
069F  E205 09ED             LDR   D,WJV5,WJSFLL       GET LOWER LIMIT (LOWER)        353
06A1  B053                  CMP   R,WJV3,WJV5         COMPARE UPPER AND LOWER LIMITS (LOWE 354
06A2  C106 0668             BRCL  LE,WJ601            LESS OR EQUAL, TRY AGAIN       355
06A4                        DS    10                  SPACE FOR PATCHES              356
                     .                                                              357
                     : OUTPUT TITLE AND GET FREQUENCY INCREMENT (8000HZ MAX)         358
                     .                                                              359
06AE  E101 0BB1    WJ603  LDR   I,WJV1,WJSFI        GET ADDRESS OF FREQ INC TITLE  360
06E0  ED00 07AE             BAL   I,RET,WJ90          OUTPUT TITLE AND GET ENTRY     361
06E2  C107 06AE             BRCL  U,WJ603             ILLEGAL ENTRY                  362
06E4  E833                  SHD   RL,WJV3,4           POSITION INCREMENT             363
06E5  2042                  CMP   IS,WJV2,4           COMPARE COUNT WITH MAX         364
06E6  C101 06AE             BRCL  GT,WJ603            ILLEGAL - TOO LARGE            365
06E8  B103 0800             CMP   I,WJV3,0800         COMPARE WITH MAX INCREMENT     366
06EA  C101 06AE             BRCL  GT,WJ603            ILLEGAL - TOO LARGE            367
06EC  2013                  CMP   IS,WJV3,1           COMPARE WITH MIN INCREMENT     368
06ED  C104 06AE             BRCL  LT,WJ603            ILLEGAL - TOO SMALL            369
06EF  9C03 09EE             STR   D,WJV3,WJSFIN       SAVE INCREMENT                 370
06C1                        DS    10                  SPACE FOR PATCHES              371
                     .                                                              372
```

```
LOC   OBJECT CODE     CARD IMAGE                                                                    CARDNUM
                    . OUTPUT TITLE AND GET SIGNAL STRENGTH                                            373
                    .                                                                                 374
06CB  E101 0BBE   WJ604     LDR   I,WJV1,WJSSS        GET ADDRESS OF SIGNAL STRENGTH TITLE          375
06CD  ED00 07AE             BAL   I,RET,WJ90          OUTPUT TILE AND GET ENTRY                     376
06CF  C107 06CB             BRCL  U,WJ604             ILLEGAL ENTRY                                 377
06D1  B103 0100             CMP   I,WJV3,0100         COMPARE WITH MAX VALUE                        378
06D3  C101 06CB             BRCL  GT,WJ604            ILLEGAL - TOO LARGE                           379
06D5  2032                  CMP   IS,WJV2,3           COMPARE COUNT WITH MAX                        380
06D6  C101 06CB             BRCL  GT,WJ604            ILLEGAL - TOO LARGE                           381
06D8  E032                  LDR   R,WJV2,WJV3         PUT SIGNAL STRENGTH IN REG 2                  382
06D9  ED00 098E             BAL   I,RET,WJBCDH        CONVERT BCD TO HEX                            383
06DB  CD01 007F             MUL   I,WJV1,07F          MULTIPLY BY 127                               384
06DD  6321                  ADD   IS,WJV1,032         ROUND                                         385
06DE  4643                  LDR   IS,WJV3,064         SET UP DIVISOR                                386
06DF  FC31                  DIV   R,WJV1,WJV3         DIVIDE BY 100                                 387
06E0  A102 007F             AND   I,WJV2,07F          CLEAR ALL BUT VALUE WANTED                    388
06E2  9C02 09EF             STR   D,WJV2,WJSFSS       STORE DESIRED SIGNAL STRENGTH                 389
06E4                        DS    10                  SPACE FOR PATCHES                             390
                    .                                                                                 391
                    . OUTPUT FREQUENCY TO RECEIVER AND GET RESPONSE                                   392
                    .                                                                                 393
06EE  E205 09ED   WJ605     LDR   D,WJV5,WJSFLL       GET LOWER LIMIT (LOWER)                       394
06F0  E206 09EC             LDR   D,WJV6,WJSFLU       GET LOWER LIMIT (UPPER)                       395
06F2  F835          WJ606   SHD   LL,WJV5,4           POSITION FREQUENCY FOR WJ                     396
06F3  E203 09C9             LDR   D,WJV3,WJCW2        GET CONTROL WORD 2 (FREQ LOWER)               397
06F5  E204 09C8             LDR   D,WJV4,WJCW1        GET CONTROL WORD 1 (FREQ UPPER)               398
06F7  A103 000F             AND   I,WJV3,0F           CLEAR OLD FREQ (LOWER)                        399
06F9  A104 0000             AND   I,WJV4,0            CLEAR OLD FREQ (UPPER)                        400
06FB  A453                  IOR   R,WJV3,WJV5         PUT IN NEW FREQ (LOWER)                       401
06FC  A464                  IOR   R,WJV4,WJV6         PUT IN NEW FREQ (UPPER)                       402
06FD  9C03 09C9             STR   D,WJV3,WJCW2        SAVE NEW CONTROL WORD 2                       403
06FF  9C04 09C8             STR   D,WJV4,WJCW1        SAVE NEW CONTROL WORD 1                       404
0701  ED00 08AE             BAL   I,RET,WJS           SEND /RECEIVE NEW CONTROL WORD                405
0703                        DS    10                  SPACE FOR PATCHES                             406
                    .                                                                                 407
                    . COMPARE RECEIVED SIGNAL STRENGTH WITH SET SIGNAL STRENGTH                       408
                    .                                                                                 409
070D  E201 09CF             LDR   D,WJV1,WJRS4        GET RECEIVED WORD 4                           410
070F  A101 007F             AND   I,WJV1,07F          CLEAR ALL BUT SIGNAL STRENGTH                 411
0711  E202 09EF             LDR   D,WJV2,WJSFSS       GET SPECIFIED SIGNAL STRENGTH                 412
0713  B021                  CMP   R,WJV1,WJV2         COMPARE RECEIVED WITH SPECIFIED               413
0714  C103 074E             BRCL  GE,WJ609            FIND                                          414
0716                        DS    10                  SPACE FOR PATCHES                             415
                    .                                                                                 416
                    . INCREMENT FREQUENCY AND TRY AGAIN                                               417
                    .                                                                                 418
0720  E201 09C9             LDR   D,WJV1,WJCW2        GET LAST FREQ (LOWER)                         419
0722  E202 09C8             LDR   D,WJV2,WJCW1        GET LAST FREQ (UPPER)                         420
0724  E831                  SHD   RL,WJV1,4           POSITION FOR INCREMENT                        421
0725  A102 03FF             AND   I,WJV2,03FF         CLEAR ALL BUT FREQUENCY                       422
0727  E203 09EE             LDR   D,WJV3,WJSFIN       GET INCREMENT                                 423
0729  4004                  IDR   IS,WJV4,0           CLEAR REGISTER                                424
072A  ED00 0861             BAL   I,RET,WJ96          INCREMENT FREQUENCY                           425
```

```
LOC   OBJECT CODE     CARD IMAGE                                                                CARDNUM
072C  E201 09EB             LDR   D,WJV1,WJSFUL      GET UPPER LIMIT (LOWER)                        426
072E  E202 09EA             LDR   D,WJV2,WJSFUU      GET UPPER LIMIT (UPPER)                        427
0730  B062                  CMP   R,WJV2,WJV6        COMPARE UPPER LIMIT AND FREQ (UPPER)           428
0731  C101 06F2             BRCL  GT,WJ606           FREQ BELOW LIMIT, KEEP LOOKING                 429
0733  C102 073F             BRCL  EQ,WJ608           UPPER FREQ MATCH,CHECK LOWERS                  430
0735  E201 09F0  WJ607      LDR   D,WJV1,WJSCNT      GET COUNT OF NO. OF TIME THRU                  431
0737  6011                  ADD   IS,WJV1,1          INCREMENT COUNT                                432
0738  2641                  CMP   IS,WJV1,100        COMPARE WITH MAX TIMES THRU                    433
0739  C101 075E             BRCL  GT,WJ610           DONE - NO FIND                                 434
073B  9C01 09F0             STR   D,WJV1,WJSCNT      SAVE NEW COUNT                                 435
073D  C107 06EE             BRCL  U,WJ605            GO START AT LOWER LIMIT AGAIN                  436
073F  B051          WJ608   CMP   R,WJV1,WJV5        COMPARE LOWERS OF UPPER LIMIT AND FR           437
0740  C104 0735             BRCL  LT,WJ607           LESS, GO START AGAIN                           438
0742  C107 06F2             BRCL  U,WJ606            GO DO WITH NEW FREQUENCY                       439
0744                        DS    10                 SPACE FOR PATCHES                              440
                                                                                                   441
                    . FIND                                                                         442
                    .                                                                              443
C74E  BC11 09E0     WJ609   LDRM  D,WJV1,WJRFL,2     GET RECEIVED FREQUENCY (DISPLAY)               444
0750  9C11 09D8             STRM  D,WJV1,WJCFL,2     STORE IN CONTROL FREQ (DISPLAY)                445
0752  C107 05DE             BRCL  U,WJ40             GO DISPLAY RECEIVED WORD                       446
0754                        DS    10                 SPACE FOR PATCHES                              447
                    .                                                                              448
                    . NO FIND - TELL OPERATOR                                                      449
                    .                                                                              450
075E  BC11 09E0     WJ610   LDRM  D,WJV1,WJRFL,2     GET LAST RECEIVED FREQ (DISPLAY)               451
0760  9C11 09D8             STRM  D,WJV1,WJCFL,2     STORE IN CONTROL FREQ (DISPLAY)                452
0762  E101 0ECA             LDR   I,WJV1,WJSNF       GET ADDRESS OF NO FIND MESSAGE                 453
0764  ED00 0230             BAL   I,RET,OUTPUT       OUTPUT MESSAGE                                 454
0766  C107 0519             BRCL  U,WJ02             DONE                                           455
0768                        DS    40                 SPACE FOR PATCHES                              456
                    .                                                                              457
                    .                                                                              458
                    .                                                                              459
                    .                                                                              460
                    . ********************************************                                   461
                    . RECEIVE CONTROL WORD FROM RECEIVER (COMMAND=6)                               462
                    . ********************************************                                   463
                    .                                                                              464
0790  E101 0001     WJ70    LDR   I,WJV1,01          LOAD FLAG TO INHIBIT COMPARE                   465
0792  9C01 09F4             STR   D,WJV1,CHKFLG1     STORE FLAG                                     466
0794  ED00 08E1             BAL   I,RET,WJR          INPUT RECEIVER CONTROL WORDS                   467
0796  E101 0000             LDR   I,WJV1,0           ZERO REGISTER                                  468
0798  9C01 09F4             STR   D,WJV1,CHKFLG1     CLEAR FLAG                                     469
079A  C107 05DE             BRCL  U,WJ40             DISPLAY RECEIVED WORDS                         470
079C  C107 0519             BRCL  U,WJ02             RETURN                                         471
079E                        DS    10                 SPACE FOR PATCHES                              472
                    .                                                                              473
                    .                                                                              474
                    .                                                                              475
                    .                                                                              476
                    . ***************                                                              477
                    . DONE (COMMAND=7)                                                             478
```

```
LOC   OBJECT CODE     CARD IMAGE                                                                    CARDNUM
                    . ***************                                                                 479
                    .                                                                               480
07A8  B601 09B4     WJ80      LLC   D,WJV1,WJCRF          LOAD "ADDRESS OFF"                        481
07AA  D912                    ROUT  02,WJV1               TURN OFF INTERFACE                        482
07AB  E200 09AD               LDR   D,RET,WJRET           LOAD RETURN ADDRESS                       483
07AD  BF07                    BRC   R,7,RET               RETURN TO CALLER                          484
                    .                                                                               485
                    .                                                                               486
                    .                                                                               487
                    .                                                                               488
                    .*****************************************************************************  489
                    . ROUTINE TO OUTPUT BUFFER AND GET ENTRY FROM KEYBOARD                          490
                    . ENTRY: WJV1 ADDRESS OF BUFFER TO BE OUTPUT                                    491
                    . EXIT:  WJV2 NUMBER OF CHARACTERS ENTERED                                      492
                    .        WJV3 ENTRY (LOWER) BCD                                                 493
                    .        WJV4 ENTRY (UPPER) BCD                                                 494
                    . RETURN FOR ILLEGAL ENTRY                                                      495
                    . RETURN+2 FOR LEGAL ENTRY                                                      496
                    .*****************************************************************************  497
                    .                                                                               498
07AE  9C00 09F1     WJ90      STR   D,RET,WJ90R           SAVE THE RETURN ADDRESS                   499
07B0  ED00 0230               BAL   I,RET,OUTPUT          OUTPUT BUFFER                             500
07B2  ED00 0151               BAL   I,RET,KEYMR           GET INPUT FROM KEYBOARD                   501
07B4  4003                    LDR   IS,WJV3,0             CLEAR REGISTER                            502
07B5  4004                    LDR   IS,WJV4,0             CLEAR REGISTER                            503
07B6  4005                    LDR   IS,WJV5,0             CLEAR REGISTER                            504
07B7  5152                    LDR   RX,WJV2,WJV5,WJV1     GET COUNT FROM KEYMR                      505
07B8  E027                    LDR   R,WJV7,WJV2           SET UP INDEX FOR LOOP                     506
07B9  E200 09F1               LDR   D,RET,WJ90R           GET RETURN ADDRESS                        507
07BB  6FF7                    ADD   IS,WJV7,-1            DECREMENT COUNT                           508
07BC  BF04                    BRC   R,4,RET               ILLEGAL IF NEG, NOTHING ENTERED           509
07BD  6011          WJ901     ADD   IS,WJV1,1             INCREMENT BUFFER POINTER                  510
07BE  5156                    LDR   RX,WJV6,WJV5,WJV1     GET ONE CHARACTER                         511
07BF  2306                    CMP   IS,WJV6,030           COMPARE CHAR WITH ASCII ZERO              512
07C0  BF04                    BRC   R,4,RET               ILLEGAL CHARACTER IS LESS                 513
07C1  2396                    CMP   IS,WJV6,039           COMPARE WITH ASCII 9                      514
07C2  BF01                    BRC   R,1,RET               ILLEGAL CHARACTER IS GREATER              515
07C3  A106 000F               AND   I,WJV6,0F             CLEAR UPPER 12 BITS                       516
07C5  F833                    SHD   LL,WJV3,4             POSITION ENTRY FOR NEW CHARACTER          517
07C6  A463                    IOR   R,WJV3,WJV6           OR IN NEW CHARACTER                       518
07C7  6FF7                    ADD   IS,WJV7,-1            DECREMENT COUNT                           519
07C8  C103 07BD               BRCL  NN,WJ901            KEEP GOING IF MORE CHARACTERS               520
07CA  6020                    ADD   IS,RET,2              INCREMENT RETURN ADDRESS                  521
07CB  BF07                    BRC   R,7,RET               LEGAL RETURN                              522
                    .                                                                               523
                    .                                                                               524
                    .                                                                               525
                    .                                                                               526
                    .*****************************************************************************  527
                    . ROUTINE TO CHECK A FREQUENCY ENTRY AND MAKE SURE IT IS IN WJ                  528
                    . FREQUENCY LIMITS                                                              529
                    . ENTRY: WJV2  NUMBER OF CHARACTERS ENTERED                                     530
                    .        WJV3 FREQUENCY (LOWER) BCD,1 HZ RESOLUTION                             531
```

```
LOC   OBJECT CODE     CARD IMAGE                                                                    CARDNUM
                    .       WJV4 FREQUENCY (UPPER) BCD,1HZ RESOLUTION                                  532
                    . EXIT: WJV3 FREQUENCY (LOWER) BCD,10 HZ RESOLUTION                                533
                    .       WJV4 FREQUENCY (UPPER) BCD,10 HZ RESOLUTION                                534
                    . RETURN FOR ILLEGAL ENTRY                                                         535
                    . RETURN+2 FOR LEGAL ENTRY                                                         536
                    .*******************************************************************             537
                    .                                                                                  538
07CC  2082          WJ91    CMP   IS,WJV2,8          COMPARE WITH MAX COUNT                          539
07CD  BF01                  BRC   R,1,RET            ILLEGAL - TOO MANY                              540
07CE  2062                  CMP   IS,WJV2,6          COMPARE COUNT WITH MIN                          541
07CF  BF04                  BRC   R,4,RET            ILLEGAL - TOO FEW                               542
07D0  E833                  SHD   RL,WJV3,4          POSITION FREQUENCY FOR WJ                       543
07D1  B104 0305             CMP   I,WJV4,0305        COMPARE WITH MAX FREQUENCY                      544
07D3  BF01                  BRC   R,1,RET            ILLEGAL - TOO LARGE                             545
07D4  B104 0005             CMP   I,WJV4,05          COMPARE WITH MIN FREQUENCY                      546
07D6  BF04                  BRC   R,4,RET            ILLEGAL - TOO SMALL                             547
07D7  6020                  ADD   IS,RET,2           INCREMENT RETURN ADDRESS                        548
07D8  BF07                  BRC   R,7,RET            LEGAL RETURN                                    549
                    .                                                                                  550
                    .                                                                                  551
                    .                                                                                  552
                    .                                                                                  553
                    .*******************************************************************             554
                    . ROUTINE TO DISPLAY FREQUENCY                                                     555
                    . WJV1 FREQUENCY (LOWER) IN DISPLAY FORMAT                                         556
                    . WJV2 FREQUENCY (UPPER) IN DISPLAY FORMAT                                         557
                    .*******************************************************************             558
                    .                                                                                  559
07D9  9C00 09F1     WJ92    STR   D,RET,WJ90R        SAVE RETURN ADDRESS                             560
07DB  E104 3030             LDR   I,WJV4,03030       SET UP ASCII CONVERSION CONSTANT                561
07DD  4003                  LDR   IS,WJV3,0          CLEAR REGISTER                                  562
07DE  F831                  SHD   LL,WJV1,4          SET FREQUENCY TO 1 HZ RESOLUTION                563
07DF  F832                  SHD   LL,WJV2,4          POSITION 1ST 2 DIGITS                           564
07E0  AE33                  SHS   LL,WJV3,4                                                          565
07E1  F832                  SHD   LL,WJV2,4                                                          566
07E2  A443                  IOR   R,WJV3,WJV4        CONVERT TO ASCII                                567
07E3  9C03 0ADD             STR   D,WJV3,WJDF1       PUT 1ST 2 DIGITS IN DISPLAY BUFFER              568
07E5  4003                  LDR   IS,WJV3,0          CLEAR REGISTER                                  569
07E6  F832                  SHD   LL,WJV2,4          POSITION 2ND 2 DIGITS                           570
07E7  AE33                  SHS   LL,WJV3,4                                                          571
07E8  F832                  SHD   LL,WJV2,4                                                          572
07E9  A443                  IOR   R,WJV3,WJV4        CONVERT TO ASCII                                573
07EA  9C03 0ADE             STR   D,WJV3,WJDF1+1     PUT IN DISPLAY BUFFER                           574
07EC  4002                  LDR   IS,WJV2,0          CLEAR REGISTER                                  575
07ED  F831                  SHD   LL,WJV1,4          POSITION 3RD 2 DIGITS                           576
07EE  AE32                  SHS   LL,WJV2,4                                                          577
07EF  F831                  SHD   LL,WJV1,4                                                          578
07F0  A442                  IOR   R,WJV2,WJV4        CONVERT TO ASCII                                579
07F1  9C02 0ADF             STR   D,WJV2,WJDF1+2     PUT IN DISPLAY BUFFER                           580
07F3  4002                  LDR   IS,WJV2,0          CLEAR REGISTER                                  581
07F4  F831                  SHD   LL,WJV1,4          POSITION LAST 2 DIGITS                          582
07F5  AE32                  SHS   LL,WJV2,4                                                          583
07F6  F831                  SHD   LL,WJV1,4                                                          584
```

```
LOC   OBJECT CODE     CARD IMAGE                                                                    CARDNUM
07F7  A442            IOR   R,WJV2,WJV4          CONVERT TO ASCII                                    585
07F8  9C02 0AE0       STR   D,WJV2,WJDF1+3       PUT IN DISPLAY BUFFER                               586
07FA  E101 0AD8       LDR   I,WJV1,WJDF          GET ADDRESS OF OUTPUT BUFFER                        587
07FC  ED00 0230       BAL   I,RET,OUTPUT         OUTPUT BUFFER                                       588
07FE  E200 09F1       LDR   D,RET,WJ90R          GET RETURN ADDRESS                                  589
0800  BF07            BRC   R,7,RET              RETURN TO CALLER                                    590
                      .                                                                              591
                      .                                                                              592
                      .                                                                              593
                      .                                                                              594
                      .**************************************************************************  595
                      . ROUTINE TO DISPLAY GAIN MODE AND IF BANDWIDTH                               596
                      . WJV1 GAIN MODE IN DISPLAY FORMAT                                            597
                      . WJV2 IF BANDWIDTH IN DISPLAY FORMAT                                         598
                      .**************************************************************************  599
                      .                                                                              600
0801  9C00 09F1 WJ93  STR   D,RET,WJ90R          SAVE RETURN ADDRESS                                 601
0803  9C02 09F2       STR   D,WJV2,WJ90S1        SAVE IF BANDWIDTH                                   602
0805  9C01 09F3       STR   D,WJV1,WJ90S2        SAVE GAIN MODE                                      603
0807  E101 0AFB       LDR   I,WJV1,WJDGM         GET ADDRESS OF BUFFER TO OUTPUT                     604
0809  ED00 0230       BAL   I,RET,OUTPUT         OUTPUT BUFFER                                       605
080B  E202 09F3       LDR   D,WJV2,WJ90S2        PUT GAIN MODE IN REG 2                              606
080D  E103 0B27       LDR   I,WJV3,WJGMTB        GET ADDRESS OF GAIN MODE TABLE                      607
080F  5321            LDR   RX,WJV1,WJV2,WJV3    GET ADDRESS OF BUFFER TO OUTPUT                     608
0810  ED00 0230       BAL   I,RET,OUTPUT         OUTPUT BUFFER                                       609
0812  E101 0B03       LDR   I,WJV1,WJDIF         GET ADDRESS OF BUFFER TO OUTPUT                     610
0814  ED00 0230       BAL   I,RET,OUTPUT         OUTPUT BUFFER                                       611
0816  E202 09F2       LDR   D,WJV2,WJ90S1        GET IF BANDWIDTH                                    612
0818  E103 0B42       LDR   I,WJV3,WJIFTB        GET ADDRESS OF IF BANDWIDTH TABLE                   613
081A  5321            LDR   RX,WJV1,WJV2,WJV3    GET ADDRESS OF BUFFER TO OUTPUT                     614
081B  ED00 0230       BAL   I,RET,OUTPUT         OUTPUT IF BANDWIDTH BUFFER                          615
081D  E200 09F1       LDR   D,RET,WJ90R          GET RETURN ADDRESS                                  616
081F  BF07            BRC   R,7,RET              RETURN TO CALLER                                    617
                      .                                                                              618
                      .                                                                              619
                      .                                                                              620
                      .                                                                              621
                      .**************************************************************************  622
                      . ROUTINE TO DISPLAY DETECT MODE AND BFO FREQUENCY                            623
                      . WJV1 DETECT MODE IN DISPLAY FORMAT                                          624
                      . WJV2 BFO FREQUENCY (LOWER) IN DISPLAY FORMAT                                625
                      .**************************************************************************  626
                      .                                                                              627
0820  9C00 09F1 WJ94  STR   D,RET,WJ90R          SAVE RETURN ADDRESS                                 628
0822  9C01 09F2       STR   D,WJV1,WJ90S1        SAVE DETECT MODE                                    629
0824  9C02 09F3       STR   D,WJV2,WJ90S2        SAVE BFO FREQUENCY                                  630
0826  E101 0AE5       LDR   I,WJV1,WJDDM         GET ADDRESS OF BUFFER TO OUTPUT                     631
0828  ED00 0230       BAL   I,RET,OUTPUT         OUTPUT BUFFER                                       632
082A  E202 09F2       LDR   D,WJV2,WJ90S1        GET DETECT MODE                                     633
082C  E103 0B61       LDR   I,WJV3,WJDMTB        GET ADDRESS OF DETECT MODE TABLE                    634
082E  5321            LDR   RX,WJV1,WJV2,WJV3    GET ADDRESS OF BUFFER TO OUTPUT                     635
082F  ED00 0230       BAL   I,RET,OUTPUT         OUTPUT BUFFER                                       636
0831  E201 09F3       LDR   D,WJV1,WJ90S2        GET BFO FREQUENCY                                   637
```

```
LOC   OBJECT CODE      CARD IMAGE                                                                  CARDNUM
0833  4002                    LDR   IS,WJV2,0           CLEAR REGISTER                              638
0834  F831                    SHD   LL,WJV1,4           POSITION UPPER 2 DIGITS                     639
0835  AE32                    SHS   LL,WJV2,4                                                       640
0836  F831                    SHD   LL,WJV1,4                                                       641
0837  A502 3030               IOR   I,WJV2,03030        CONVERT TO ASCII                            642
0839  9C02 0AF5               STR   D,WJV2,WJDBF1       STORE IN OUTPUT BUFFER                      643
083B  4002                    LDR   IS,WJV2,0           CLEAR REGISTER                              644
083C  F831                    SHD   LL,WJV1,4           POSITION LOWER 2 DIGITS                     645
083D  AE32                    SHS   LL,WJV2,4                                                       646
083E  F831                    SHD   LL,WJV1,4                                                       647
083F  A502 3030               IOR   I,WJV2,03030        CONVERT TO ASCII                            648
0841  9C02 0AF6               STR   D,WJV2,WJDBF1+1     STORE IN OUTPUT BUFFER                      649
0843  E101 0AEE               LDR   I,WJV1,WJDBF        GET ADDRESS OF BUFFER TO OUTPUT             650
0845  ED00 0230               BAL   I,RET,OUTPUT        OUTPUT BUFFER                               651
0847  E200 09F1               LDR   D,RET,WJ90R         GET RETURN ADDRESS                          652
0849  BF07                    BRC   R,7,RET             RETURN TO CALLER                            653
                                                                                                    654
                                .                                                                   655
                                .                                                                   656
                                .                                                                   657
                                .*************************************************************      658
                                . ROUTINE TO DISPLAY RF GAIN                                        659
                                . WJV1 RF GAIN IN DISPLAY FORMAT                                    660
                                .*************************************************************      661
                                .                                                                   662
084A  9C00 09F1         WJ95    STR   D,RET,WJ90R         SAVE RETURN ADDRESS                         663
084C  4002                    LDR   IS,WJV2,0           CLEAR REGISTER                              664
084D  F871                    SHD   LL,WJV1,8           POSITION FIRST DIGIT                        665
084E  A502 2030               IOR   I,WJV2,02030        CONVERT TO ASCII                            666
0850  9C02 0B13               STR   D,WJV2,WJDRF1       STORE IN DISPLAY BUFFER                     667
0852  4002                    LDR   IS,WJV2,0           CLEAR REGISTER                              668
0853  F831                    SHD   LL,WJV1,4           POSITION LAST 2 DIGITS                      669
0854  AE32                    SHS   LL,WJV2,4                                                       670
0855  F831                    SHD   LL,WJV1,4                                                       671
0856  A502 3030               IOR   I,WJV2,03030        CONVERT TO ASCII                            672
0858  9C02 0B14               STR   D,WJV2,WJDRF1+1     STORE IN DISPLAY BUFFER                     673
085A  E101 0B0D               LDR   I,WJV1,WJDRF        GET ADDRESS OF BUFFER TO OUTPUT             674
085C  ED00 0230               BAL   I,RET,OUTPUT        OUTPUT BUFFER                               675
085E  E200 09F1               LDR   D,RET,WJ90R         GET RETURN ADDRESS                          676
0860  BF07                    BRC   R,7,RET             RETURN TO CALLER                            677
                                                                                                    678
                                .                                                                   679
                                .                                                                   680
                                .                                                                   681
                                .*************************************************************      682
                                . ROUTINE TO INCREMENT FREQUENCY                                    683
                                . WJV1 FREQUENCY IN DISPLAY FORMAT (LOWER)                          684
                                . WJV2 FREQUENCY IN DISPLAY FORMAT (UPPER)                          685
                                . WJV3 FREQUENCY INCREMENT IN DISPLAY FORMAT (LOWER)                686
                                . WJV4 FREQUENCY INCREMENT IN DISPLAY FORMAT (UPPER)                687
                                . WJV5 ANSWER FREQUENCY IN DISPLAY FORMAT (LOWER)                   688
                                . WJV6 ANSWER FREQUENCY IN DISPLAY FORMAT (UPPER)                   689
                                .*************************************************************      690
```

```
LOC   OBJECT CODE      CARD IMAGE                                                    CARDNUM

                                                                                       691
0861  9C00 09F1  WJ96      STR   D,RET,WJ90R       SAVE RETURN ADDRESS               692
0863  E109 000F            LDR   I,WJV9,0000F      SET UP MASK                       693
0865  4005                LDR   IS,WJV5,0         CLEAR REGISTER                    694
0866  4006                LDR   IS,WJV6,0         CLEAR REGISTER                    695
0867  E017                LDR   R,WJV7,WJV1       DO 1ST DIGIT                      696
0868  E038                LDR   R,WJV8,WJV3                                         697
0869  ED00 08A4           BAL   I,RET,WJ961                                         698
086B  E075                LDR   R,WJV5,WJV7                                         699
086C  E017                LDR   R,WJV7,WJV1       DO 2ND DIGIT                      700
086D  AD37                SHS   RL,WJV7,4                                           701
086E  8087                ADD   R,WJV7,WJV8                                         702
086F  E038                LDR   R,WJV8,WJV3                                         703
0870  AD38                SHS   RL,WJV8,4                                           704
0871  ED00 08A4           BAL   I,RET,WJ961                                         705
0873  AE37                SHS   LL,WJV7,4                                           706
0874  A475                IOR   R,WJV5,WJV7                                         707
0875  E017                LDR   R,WJV7,WJV1       DO 3RD DIGIT                      708
0876  AD77                SHS   RL,WJV7,8                                           709
0877  8087                ADD   R,WJV7,WJV8                                         710
0878  E038                LDR   R,WJV8,WJV3                                         711
0879  AD78                SHS   RL,WJV8,8                                           712
087A  ED00 08A4           BAL   I,RET,WJ961                                         713
087C  AE77                SHS   LL,WJV7,8                                           714
087D  A475                IOR   R,WJV5,WJV7                                         715
087E  E017                LDR   R,WJV7,WJV1       DO 4TH DIGIT                      716
087F  ADB7                SHS   RL,WJV7,12                                          717
0880  8087                ADD   R,WJV7,WJV8                                         718
0881  E038                LDR   R,WJV8,WJV3                                         719
0882  ADB8                SHS   RL,WJV8,12                                          720
0883  ED00 08A4           BAL   I,RET,WJ961                                         721
0885  AEB7                SHS   LL,WJV7,12                                          722
0886  A475                IOR   R,WJV5,WJV7                                         723
0887  E027                LDR   R,WJV7,WJV2       DO 5TH DIGIT                      724
0888  8087                ADD   R,WJV7,WJV8                                         725
0889  E048                LDR   R,WJV8,WJV4                                         726
088A  ED00 08A4           BAL   I,RET,WJ961                                         727
088C  E076                LDR   R,WJV6,WJV7                                         728
088D  E027                LDR   R,WJV7,WJV2       DO 6TH DIGIT                      729
088E  AD37                SHS   RL,WJV7,4                                           730
088F  8087                ADD   R,WJV7,WJV8                                         731
0890  E048                LDR   R,WJV8,WJV4                                         732
0891  AD38                SHS   RL,WJV8,4                                           733
0892  ED00 08A4           BAL   I,RET,WJ961                                         734
0894  AE37                SHS   LL,WJV7,4                                           735
0895  A476                IOR   R,WJV6,WJV7                                         736
0896  E027                LDR   R,WJV7,WJV2       DO 7TH DIGIT                      737
0897  AD77                SHS   RL,WJV7,8                                           738
0898  8087                ADD   R,WJV7,WJV8                                         739
0899  E048                LDR   R,WJV8,WJV4                                         740
089A  AD78                SHS   RL,WJV8,8                                           741
089B  ED00 08A4           BAL   I,RET,WJ961                                         742
089D  AE77                SHS   LL,WJV7,8                                           743
```

```
LOC   OBJECT CODE      CARD IMAGE                                                    CARDNUM
089E  A476                  IOR   R,WJV6,WJV7                                          744
089F  AE88                  SHS   LL,WJV8,12          DO LAST DIGIT                  745
08A0  A486                  IOR   R,WJV6,WJV8                                        746
08A1  E200 09F1             LDR   D,RET,WJ90R         GET RETURN ADDRESS             747
08A3  BF07                  BRC   R,7,RET             RETURN                         748
                      .                                                              749
08A4  A097            WJ961 AND   R,WJV7,WJV9         CLEAR ALL BUT DIGIT            750
08A5  A098                  AND   R,WJV8,WJV9         CLEAR ALL BUT DIGIT            751
08A6  8087                  ADD   R,WJV7,WJV8         ADD DIGITS TOGETHER            752
08A7  4008                  LDR   IS,WJV8,0           CLEAR REGISTER                 753
08A8  20A7                  CMP   IS,WJV7,10          COMPARE WITH DECIMAL 10        754
08A9  C104 08AD             BRCL  LT,WJ962            LESS - NO CARRY                755
08AB  6F67                  ADD   IS,WJV7,-10         DECREMENT ANSWER BY 10         756
08AC  4018                  LDR   IS,WJV8,1           CARRY ONE                      757
08AD  BF07            WJ962 BRC   R,7,RET             RETURN TO CALLER               758
                      .                                                              759
                      .                                                              760
                      .                                                              761
                      .                                                              762
                      .**************************************************************763
                      . SEND START CODE TO RECEIVER                                  764
                      . SEND CONTROL WORD TO RECEIVER                                765
                      . SEND END CODE TO RECEIVER                                    766
                      .**************************************************************767
                      .                                                              768
08AE  B60B 09AE       WJS   LLC   D,WJXX,WJCRS        XAR  FOR RCVR CHECK            769
08E0  B603 09B0             LLC   D,WJX1,WJCRD1       XAR FOR CONTROL WORD ONE       770
08E2  B604 09B1             LLC   D,WJX2,WJCRD2       XAR FOR CONTROL WORD TWO       771
08E4  B605 09B2             LLC   D,WJX3,WJCRD3       "     "       "   THREE        772
08E6  B606 09B3             LLC   D,WJX4,WJCRD4       "     "       "   FOUR         773
08B8  B602 09AF             LLC   D,WJXE,WJCRE        XAR FOR END OF LOAD            774
08EA  E207 09C8             LDR   D,WJD1,WJCW1        CONTROL WORD ONE               775
08BC  E208 09C9             LDR   D,WJD2,WJCW2        TWO                            776
08EE  E209 09CA             LDR   D,WJD3,WJCW3        THREE                          777
08C0  E20A 09CB             LDR   D,WJD4,WJCW4        FOUR                           778
08C2  D937                  ROUT  WJD1,WJX1           SEND DATA WORD 1               779
08C3  D948                  ROUT  WJD2,WJX2           SEND DATA WORD 2               780
08C4  D959                  ROUT  WJD3,WJX3           SEND DATA WORD 3               781
08C5  D96A                  ROUT  WJD4,WJX4           SEND DATA WORD 4               782
08C6  8CB1            WJS1  RIN   WJV1,WJXX           INPUT RCVR CHECK WORD          783
08C7  E20F 09F5             LDR   D,WJLPC,WJLPL       LOAD COUNTER                   784
08C9  601F                  ADD   IS,WJLPC,01         INCREMENT COUNTER              785
08CA  B10F 0014             CMP   I,WJLPC,20          COMPARE WITH 32 TIMES          786
08CC  C103 09A4             BRCL  GE,WJCKF            BRANCH IF GREATER OR EQUAL     787
08CE  9C0F 09F5             STR   D,WJLPC,WJLPL       SAVE COUNT                     788
08D0  9E01 0001             CMPL  I,WJV1,01           CHECK TO SEE IF READY          789
08D2  C105 08C6             BRCL  NE,WJS1             LOOP IF NOT READY              790
08D4  D921                  ROUT  WJV1,WJXE           SEND TRIGGER                   791
08D5  400F                  LDR   IS,WJLPC,0          ZERO COUNTER                   792
08D6  9C0F 09F5             STR   D,WJLPC,WJLPL       STORE COUNT                    793
08D8  E20F 09F6             LDR   D,WJLPC,WJLPK       LOAD WJS COUNTER               794
08DA  601F                  ADD   IS,WJLPC,01         INCREMENT COUNTER              795
08DB  B10F 0005             CMP   I,WJLPC,05          FIVE TIMES THROUGH?            796
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
08DD  C103 09A4             BRCL  GE,WJCKF          YES-EXIT / NO-CONTINUE            797
08DF  9C0F 09F6             STR   D,WJLPC,WJLPK     SAVE COUNT                        798
                                                                                      799
                      .                                                               800
                      .                                                               801
                      .                                                               802
                      .*************************************************************** 803
                      . SEND 'START TO SEND' CODE TO RECEIVER                         804
                      . GET CONTROL WORD FROM RECEIVER                                805
                      . SEND 'END OF SEND' TO RECEIVER                                806
                      . CONVERT RECEIVED WORD TO DISPLAY FORMAT                       807
                      .*************************************************************** 808
                      .                                                               809
08E1  9C00 09F1  WJR        STR   D,RET,WJ90R       SAVE RETURN ADDRESS               810
08E3  E60B 09AE             LLC   D,WJXX,WJCRS      XAR FOR RECEIVER CHECK            811
08E5  B601 09B9             LLC   D,WJXS,WJRCB      XAR  TO START LOAD/STOP MON CLK   812
08E7  B603 09B5             LLC   D,WJX1,WJRCD1     XAR FOR CONTROL WORD ONE          813
08E9  B604 09B6             LLC   D,WJX2,WJRCD2     TWO                               814
08EB  B605 09B7             LLC   D,WJX3,WJRCD3     THREE                             815
08ED  B606 09B8             LLC   D,WJX4,WJRCD4     FOUR                              816
08EF  B602 09BA             LLC   D,WJXE,WJRCE      XAR TO END INPUT/START MON CLK    817
08F1  8CB7       WJR1       RIN   WJD1,WJXX         INPUT CHECK                       818
08F2  E20F 09F5             LDR   D,WJLPC,WJLPL     LOAD COUNTER                      819
08F4  601F                  ADD   IS,WJLPC,01       INCREMENT COUNTER                 820
08F5  B10F 0014             CMP   I,WJLPC,20        COMPARE WITH 32 TIMES             821
08F7  C103 09A4             BRCL  GE,WJCKF          BRANCH IF GREATER OR EQUAL        822
08F9  9C0F 09F5             STR   D,WJLPC,WJLPL     SAVE COUNT                        823
08FB  9E07 0001             CMPL  I,WJD1,01         CHECK TO SEE IF READY             824
08FD  C105 08F1             BRCL  NE,WJR1           LOOP IF NOT READY                 825
08FF  D917                  ROUT  WJD1,WJXS         STOP MONITOR CLOCK                826
0900  8C37                  RIN   WJD1,WJX1         INPUT FIRST CONTROL WORD          827
0901  8C48                  RIN   WJD2,WJX2         SECOND                            828
0902  8C59                  RIN   WJD3,WJX3         THIRD                             829
0903  8C6A                  RIN   WJD4,WJX4         FOURTH                            830
0904  D927                  ROUT   WJD1,WJXE        START MONITOR CLOCK               831
0905  9C37 09CC             STRM  D,WJD1,WJRS1,4    STORE RECEIVED DATA WORDS         832
0907  E201 09F4             LDR   D,WJV1,CHKFLG1    LOAD REG 1 FOR CHECK              833
0909  9E01 0001             CMPL  I,WJV1,01         CHECK FOR COMMAND 6               834
090B  C102 0921             BRCL  EQ,WJR2           COMMAND 6=BRANCH                  835
090D  E204 09C8             LDR   D,WJV4,WJCW1      CONTROL WORD ONE                  836
090F  E205 09C9             LDR   D,WJV5,WJCW2      TWO                               837
0911  E206 09CA             LDR   D,WJV6,WJCW3      THREE                             838
0913  B047                  CMP   R,WJD1,WJV4       COMPARE SENT AND RECEIVED WORDS 1 839
0914  C105 08AE             ERCL  NE,WJS            NOT THE SAME-SEND AGAIN           840
0916  B058                  CMP   R,WJD2,WJV5       COMPARE 2                         841
0917  C105 08AE             BRCL  NE,WJS            NOT THE SAME-SEND AGAIN           842
0919  B069                  CMP   R,WJD3,WJV6       COMPARE 3                         843
091A  C105 08AE             BRCL  NE,WJS            NOT THE SAME-SEND AGAIN           844
091C  400F                  IDR   IS,WJLPC,0        ZERO COUNTER                      845
091D  9C0F 09F5             STR   D,WJLPC,WJLPL     STORE COUNT                       846
091F  9C0F 09F6             STR   D,WJLPC,WJLPK     SAVE COUNT                        847
0921  E202 09CC  WJR2       LDR   D,WJV2,WJRS1      GET FREQUENCY UPPER               848
0923  E201 09CD             LDR   D,WJV1,WJRS2      GET FREQUENCY LOWER               849
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
0925  E831            SHD   RL,WJV1,4       POSITION FREQUENCY FOR DISPLAY           850
0926  A102 03FF       AND   I,WJV2,03FF     CLEAR ALL BUT FREQUENCY                  851
0928  9C01 09E0       STR   D,WJV1,WJRFL    STORE IN RECEIVED DISPLAY (LOWER)        852
092A  9C02 09E1       STR   D,WJV2,WJRFU    STORE IN RECEIVED DISPLAY (UPPER)        853
092C  E201 09CD       LDR   D,WJV1,WJRS2    GET RECEIVED WORD 2                      854
092E  A101 000C       AND   I,WJV1,0C       CLEAR ALL BUT GAIN MODE                  855
0930  AD11            SHS   RL,WJV1,2       POSITION GAIN MODE                       856
0931  9C01 09E5       STR   D,WJV1,WJRGM    STORE IN RECEIVED GAIN MODE FOR DISP     857
0933  E201 09CE       LDR   D,WJV1,WJRS3    GET RECEIVED WORD 3                      858
0935  E202 09CD       LDR   D,WJV2,WJRS2    GET RECEIVED WORD 2                      859
0937  F801            SHD   LL,WJV1,1       POSITION RECEIVED BANDWIDTH              860
0938  A102 0007       AND   I,WJV2,07       CLEAR ALL BUT BANDWIDTH                  861
093A  9C02 09E7       STR   D,WJV2,WJRIF    STORE IN RECEIVED DISPLAY                862
093C  A101 E000       AND   I,WJV1,0E000    CLEAR ALL BUT DETECT MODE                863
093E  ADC1            SHS   RL,WJV1,13      POSITION DETECT MODE                     864
093F  9C01 09E2       STR   D,WJV1,WJRDM    STORE IN RECEIVED DISPLAY                865
0941  E101 0004       LDR   I,WJV1,04       GET BFO UPPER DISPLAY                    866
0943  9C01 09E4       STR   D,WJV1,WJRBU    STORE IN RECEIVED DISPLAY                867
0945  E201 09CE       LDR   D,WJV1,WJRS3    GET RECEIVED BFO FREQUENCY               868
0947  A101 07FF       AND   I,WJV1,07FF     CLEAR ALL BUT BFO FREQUENCY              869
0949  4002            LDR   IS,WJV2,0       CLEAR REG 2                              870
094A  CD01 07D0       MUL   I,WJV1,07D0     MULTIPLY BY 2000                         871
094C  E103 07FF       LDR   I,WJV3,07FF     LOAD DIVISOR                             872
094E  8101 0400       ADD   I,WJV1,0400     ROUND                                    873
0950  FC31            DIV   R,WJV1,WJV3     DIVIDE                                   874
0951  8102 1194       ADD   I,WJV2,01194    ADD 4500                                 875
0953  4003            LDR   IS,WJV3,0       CLEAR REG 3                              876
0954  40A4            LDR   IS,WJV4,10      SET UP DIVISOR                           877
0955  FC42            DIV   R,WJV2,WJV4     DIVIDE BY 10                             878
0956  E021            LDR   R,WJV1,WJV2     PUT REMAINDER IN WJV1 AS 1ST DIGIT       879
0957  E032            LDR   R,WJV2,WJV3     GET QUOTIENT                             880
0958  4003            LDR   IS,WJV3,0       CLEAR REGISTER                           881
0959  FC42            DIV   R,WJV2,WJV4     DIVIDE BY 10                             882
095A  AE32            SHS   LL,WJV2,4       POSITION 2ND DIGIT                       883
095B  A421            IOR   R,WJV1,WJV2     PUT 2ND DIGIT IN ANSWER                  884
095C  E032            LDR   R,WJV2,WJV3     GET QUOTIENT                             885
095D  4003            LDR   IS,WJV3,0       CLEAR REGISTER                           886
095E  FC42            DIV   R,WJV2,WJV4     DIVIDE BY 10                             887
095F  AE72            SHS   LL,WJV2,8       POSITION 3RD DIGIT                       888
0960  AEB3            SHS   LL,WJV3,12      POSITION 4TH DIGIT                       889
0961  A421            IOR   R,WJV1,WJV2     PUT IN 3RD DIGIT                         890
0962  A431            IOR   R,WJV1,WJV3     PUT IN 4TH DIGIT                         891
0963  9C01 09E3       STR   D,WJV1,WJRBL    STORE IN RECEIVED BFO FREQ DISPLAY (     892
0965  E202 09CF       LDR   D,WJV2,WJRS4    GET RECEIVED WORD 4                      893
0967  A102 7F00       AND   I,WJV2,07F00    CLEAR ALL BUT RF GAIN                    894
0969  AD72            SHS   RL,WJV2,8       RIGHT JUSTIFY                            895
096A  B421            LLC   R,WJV1,WJV2     COMPLEMENT                               896
096B  A101 007F       AND   I,WJV1,07F      CLEAR ALL BUT RF GAIN                    897
096D  ED00 097C       BAL   I,RET,WJR3      CONVERT TO BCD PERCENTAGE                898
096F  9C01 09E6       STR   D,WJV1,WJRRFG   STORE IN RECEIVED DISPLAY                899
0971  E201 09CF       LDR   D,WJV1,WJRS4    GET RECEIVED WORD 4                      900
0973  A101 007F       AND   I,WJV1,07F      CLEAR ALL BUT SIGNAL STRENGTH            901
0975  ED00 097C       BAL   I,RET,WJR3      CONVERT TO BCD PERCENTAGE                902
```

```
LOC   OBJECT CODE      CARD IMAGE                                                                CARDNUM

0977  9C01 09E9              STR   D,WJV1,WJRSS        STORE IN RECEIVED DISPLAY                    903
0979  E200 09F1              LDR   D,RET,WJ90R        GET RETURN ADDRESS                           904
097B  BF07                   BRC   R,7,RET            RETURN TO CALLER                             905
                                                                                                  906
097C  CD01 0064    WJR3      MUL   I,WJV1,064         MULTIPLY BY 100                              907
097E  6371                   ADD   IS,WJV1,037        ROUND                                        908
097F  47F3                   LDR   IS,WJV3,07F        SET UP DIVISOR                               909
0980  FC31                   DIV   R,WJV1,WJV3        DIVIDE BY 127                                910
0981  E021                   LDR   R,WJV1,WJV2        PUT DIVIDEND IN REG 1                        911
0982  4002                   LDR   IS,WJV2,0          CLEAR REGISTER                               912
0983  40A3                   LDR   IS,WJV3,10         SET UP DIVISOR                               913
0984  FC31                   DIV   R,WJV1,WJV3        DIVIDE BY 10                                 914
0985  E014                   LDR   R,WJV4,WJV1        PUT REMAINDER IN REG 4 (DIGIT 1)             915
0986  E021                   LDR   R,WJV1,WJV2        SET UP DIVIDEND                              916
0987  4002                   LDR   IS,WJV2,0          CLEAR REGISTER                               917
0988  FC31                   DIV   R,WJV1,WJV3        DIVIDE BY 10                                 918
0989  AE31                   SHS   LL,WJV1,4          POSITION 2ND DIGIT                           919
098A  AE72                   SHS   LL,WJV2,8          POSITION 3RD DIGIT                           920
098B  A441                   IOR   R,WJV1,WJV4        COMBINE 1ST AND 2ND DIGITS                   921
098C  A421                   IOR   R,WJV1,WJV2        COMBINE ALL DIGITS                           922
098D  BF07                   BRC   R,7,RET            RETURN TO CALLER                             923
                                                                                                  924
                     .                                                                            925
                     .                                                                            926
                     .                                                                            927
                     .*************************************************************************  928
                     . BCD TO HEX ROUTINE (4 DIGIT BCD VALUE)                                     929
                     . BCD VALUE PASSED IN WJV2                                                   930
                     . HEX VALUE RETURNED IN WJV1                                                 931
                     . ROUTINE USES WJV1,WJV2,WJV3,WJV4                                           932
                     .*************************************************************************  933
                     .                                                                            934
098E  E021         WJBCDH    LDR   R,WJV1,WJV2        LOAD LEAST SIGNIFICANT BITS, PART 1          935
098F  A101 000F              AND   I,WJV1,0F          "    "       "       "  , PART 2            936
0991  AD32                   SHS   RL,WJV2,4          SHIFT FOR MULTIPLICATION                     937
0992  E023                   LDR   R,WJV3,WJV2        LOAD DUMMY REG FOR MULTIPLICATION            938
0993  A103 000F              AND   I,WJV3,15          CLEAR ALL BUT LEAST SIG BITS                 939
0995  CD03 000A              MUL   I,WJV3,10          MULTIPLY BY 16                               940
0997  8031                   ADD   R,WJV1,WJV3        ADD  ONTO ANSWER                             941
0998  AD32                   SHS   RL,WJV2,4          SHIFT FOR MULTIPLICATION                     942
0999  F023                   LDR   R,WJV3,WJV2        LOAD DUMMY REG FOR MULTIPLICATION            943
099A  A103 000F              AND   I,WJV3,15          CLEAR ALL BUT LEAST SIG BITS                 944
099C  CD03 0064              MUL   I,WJV3,064         MULTIPLY BY 100                              945
099E  8031                   ADD   R,WJV1,WJV3        ADD  ONTO ANSWER                             946
099F  AD32                   SHS   RL,WJV2,4          SHIFT FOR MULTIPLICATION                     947
09A0  CD02 03E8              MUL   I,WJV2,03E8        MULTIPLY BY 1000                             948
09A2  8021                   ADD   R,WJV1,WJV2        ADD ONTO ANSWER                              949
09A3  BF07                   BRC   R,7,RET            RETURN TO CALLER                             950
                                                                                                  951
                     .                                                                            952
                     .                                                                            953
                     .                                                                            954
                           PAGE
```

```
LOC    OBJECT CODE     CARD IMAGE                                                                CARDNUM

                       .                                                                             955
                       . ******************************                                              956
                       .  ROUTINE TO OUTPUT LOOP MESSAGE                                             957
                       . ******************************                                              958
09A4   E101 0BD2       WJCKP      LDR    I,WJV1,WJCP          LOAD ADDRESS OF OUTPUT                 959
09A6   400F                       LDR    IS,WJLPC,0           ZERO COUNTER                           960
09A7   9C0F 09F6                  STR    D,WJLPC,WJLPK        SAVE ZERO COUNT                        961
09A9   ED00 0230                  BAL    I,RET,OUTPUT         OUTPUT LOOP BUFFER                     962
09AB   C107 0519                  BRCL   U,WJ02               RETURN TO RECEIVER CONTROL             963
                       .                                                                             964
                       .                                                                             965
                       .                                                                             966
                       .                                                                             967
                       .*******************************************************************          968
                       . DATA BUFFERS                                                                969
                       .*******************************************************************          970
                       .                                                                             971
                       . RETURN ADDRESS                                                              972
09AD                   WJRET      DS     1                    SAVE RETURN ADDRESS                    973
                       .                                                                             974
                       . XAR ADDRESSES                                                               975
09AE   2300            WJCRS      DC     02300                XAR TO DETERMINE IF RECEIVER IS READY  976
09AF   2000            WJCRE      DC     02000                XAR FOR COMPLETION OF SEND/TRIGGER     977
09B0   2010            WJCRD1     DC     02010                XAR OUTPUT CONTROL WORD ONE            978
09B1   2020            WJCRD2     DC     02020                XAR OUT TWO                            979
09B2   2030            WJCRD3     DC     02030                XAR OUT THREE                          980
09B3   2100            WJCRD4     DC     02100                XAR OUT FOUR                           981
09B4   2330            WJCRF      DC     02330                DISABLE RECEIVER                       982
09B5   2230            WJRCD1     DC     02230                XAR INPUT CONTROL WORD ONE             983
09B6   2220            WJRCD2     DC     02220                XAR IN TWO                             984
09B7   2210            WJRCD3     DC     02210                XAR IN THREE                           985
09B8   2200            WJRCD4     DC     02200                XAR IN FOUR                            986
09B9   2110            WJRCB      DC     02110                XAR TO START INPUT/STOP MONITOR CLOCK  987
09BA   2120            WJRCE      DC     02120                XAR END INPUT/START MONITOR CLOCK      988
09BB   2130            WJCRO      DC     02130                ENABLE RECEIVER XAR                    989
                       .                                                                             990
                       . INITIAL CONTROL WORD                                                        991
09BC   0055            WJI1       DC     00055                INITIAL CONTROL WORD 1                 992
09BD   000A            WJI2       DC     0000A                INITIAL CONTROL WORD 2                 993
09BE   0400            WJI3       DC     00400                INITIAL CONTROL WORD 3                 994
09EF   0000            WJI4       DC     00000                INITIAL CONTROL WORD 4                 995
                       .                                                                             996
                       . INITIAL CONTROL WORD - DISPLAY FORMAT                                       997
09C0   5000            WJICD      DC     05000                CONTROL FREQUENCY (LOWER)              998
09C1   0005                       DC     00005                CONTROL FREQUENCY (UPPER)              999
09C2   0000                       DC     0                    CONTROL DETECT MODE                   1000
09C3   5500                       DC     05500                CONTROL BFO FREQUENCY (LOWER)         1001
09C4   0004                       DC     04                   CONTROL BFO FREQUENCY (UPPER)         1002
09C5   0002                       DC     00002                CONTROL GAIN MODE                     1003
09C6   0100                       DC     0100                 CONTROL RF GAIN                       1004
09C7   0004                       DC     04                   CONTROL IF BANDWIDTH                  1005
                       .                                            *                               1006
                       . CONTROL WORD                                                               1007
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
09C8                  WJCW1    DS    1          RCVR CONTROL WORD 1                 1008
09C9                  WJCW2    DS    1                            2                 1009
09CA                  WJCW3    DS    1                            3                 1010
09CB                  WJCW4    DS    1                            4                 1011
                      .                                                            1012
                      . RECEIVED WORD FROM WJ                                      1013
09CC                  WJRS1    DS    1          RCVR SENT WORD 1                    1014
09CD                  WJRS2    DS    1                         2                    1015
09CE                  WJRS3    DS    1                         3                    1016
09CF                  WJRS4    DS    1                         4                    1017
                      .                                                            1018
                      . TENTATIVE VALUES - DISPLAY FORMAT                          1019
09D0                  WJTFL    DS    1          TENTATIVE FREQ(LOWER)               1020
09D1                  WJTFU    DS    1          TENTATIVE FREQ(UPPER)               1021
09D2                  WJTDM    DS    1          TENTATIVE DETECT MODE               1022
09D3                  WJTBL    DS    1          TENTATIVE BFO FREQ(LOWER)           1023
09D4                  WJTBU    DS    1          TENTATIVE BFO FREQ (UPPER)          1024
09D5                  WJTGM    DS    1          TENTATIVE GAIN MODE                 1025
09D6                  WJTRFG   DS    1          TENTATIVE RF GAIN                   1026
09D7                  WJTIF    DS    1          TENTATIVE IF BANDWIDTH              1027
                      .                                                            1028
                      . CONTROL VALUES - DISPLAY FORMAT                            1029
09D8                  WJCFL    DS    1          CONTROL FREQUENCY (LOWER)           1030
09D9                  WJCFU    DS    1          CONTROL FREQUENCY (UPPER)           1031
09DA                  WJCDM    DS    1          CONTROL DETECT MODE                 1032
09DB                  WJCBL    DS    1          CONTROL BFO FREQUENCY (LOWER)       1033
09DC                  WJCBU    DS    1          CONTROL BFO FREQUENCY (UPPER)       1034
09DD                  WJCGM    DS    1          CONTROL GAIN MODE                   1035
09DE                  WJCRFG   DS    1          CONTROL RF GAIN                     1036
09DF                  WJCIF    DS    1          CONTROL IF BANDWIDTH                1037
                      .                                                            1038
                      . RECEIVED VALUES - DISPLAY FORMAT                           1039
09E0                  WJRFL    DS    1          RECEIVED FREQUENCY (LOWER)          1040
09E1                  WJRFU    DS    1          RECEIVED FREQUENCY (UPPER)          1041
09E2                  WJRDM    DS    1          RECEIVED DETECT MODE                1042
09E3                  WJRBL    DS    1          RECEIVED BFO FREQUENCY (LOWER)      1043
09E4                  WJRBU    DS    1          RECEIVED BFO FREQUENCY (UPPER)      1044
09E5                  WJRGM    DS    1          RECEIVED GAIN MODE                  1045
09F6                  WJRRFG   DS    1          RECEIVED RF GAIN                    1046
09E7                  WJRIF    DS    2          RECEIVED IF BANDWIDTH               1047
09E9                  WJRSS    DS    1          RECEIVED SIGNAL STRENGTH            1048
                      .                                                            1049
                      .                                                            1050
                      . SCAN VARIABLES                                             1051
09EA                  WJSFUU   DS    1          UPPER LIMIT (UPPER)                 1052
09EB                  WJSFUL   DS    1          UPPER LIMIT (LOWER)                 1053
09EC                  WJSFLU   DS    1          LOWER LIMIT (UPPER)                 1054
09ED                  WJSFLL   DS    1          LOWER LIMIT (LOWER)                 1055
09EE                  WJSFIN   DS    1          FREQUENCY INCREMENT (8 KHZ MAX)     1056
09EF                  WJSFSS   DS    1          SIGNAL STRENGTH                     1057
09F0                  WJSCNT   DS    1          COUNT OF NUMBER OF SCAN PASSES      1058
                      .                                                            1059
                      . SAVE LOCATIONS FOR ALL WJ9- ROUTINES                       1060
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
09F1                  WJ90R     DS    1                                             1061
09F2                  WJ90S1    DS    1                                             1062
09F3                  WJ90S2    DS    1                                             1063
09F4                  CHKFIG1   DS    1           FLAG FOR COMMAND 6                1064
09F5                  WJLPL     DS    1           LOOP COUNTER STORAGE              1065
09F6                  WJLPK     DS    1           WJS COUNTER STORAGE               1066
                      .                                                             1067
                      . RECEIVER CONTROL TITLE BUFFER                               1068
09F7  0009            WJT       DC    9           RECEIVER CONTROL TITLE            1069
09F8  0D0A                      DC    00D0A       CR/LF                             1070
09F9  5245                      DC    05245       RE                                1071
09FA  4345                      DC    04345       CE                                1072
09FB  4956                      DC    04956       IV                                1073
09FC  4552                      DC    04552       ER                                1074
09FD  2043                      DC    02043        C                                1075
09FE  4F4E                      DC    04F4E       ON                                1076
09FF  5452                      DC    05452       TR                                1077
0A00  4F4C                      DC    04F4C       OL                                1078
0A01  0000                      DC    0           NULL                              1079
                      .                                                             1080
                      .                                                             1081
                      . COMMANDS BUFFER                                             1082
0A02  0047            WJINS     DC    71                                            1083
0A03  303D                      DC    0303D       0=                                1084
0A04  5345                      DC    05345       SE                                1085
0A05  542D                      DC    0542D       T-                                1086
0A06  5550                      DC    05550       UP                                1087
0A07  0D0A                      DC    00D0A       CR/LF                             1088
0A08  313D                      DC    0313D       1=                                1089
0A09  4449                      DC    04449       DI                                1090
0A0A  5350                      DC    05350       SP                                1091
0A0B  4C41                      DC    04C41       LA                                1092
0A0C  5920                      DC    05920       Y                                 1093
0A0D  5445                      DC    05445       TE                                1094
0A0E  4E54                      DC    04E54       NT                                1095
0A0F  4154                      DC    04154       AT                                1096
0A10  4956                      DC    04956       IV                                1097
0A11  450D                      DC    0450D       E/CR                              1098
0A12  0A32                      DC    00A32       LF/2                              1099
0A13  3D44                      DC    03D44       =D                                1100
0A14  4953                      DC    04953       IS                                1101
0A15  504C                      DC    0504C       PL                                1102
0A16  4159                      DC    04159       AY                                1103
0A17  2043                      DC    02043        C                                1104
0A18  4F4E                      DC    04F4E       ON                                1105
0A19  5452                      DC    05452       TR                                1106
0A1A  4F4C                      DC    04F4C       OL                                1107
0A1B  0D0A                      DC    00D0A       CR/LF                             1108
0A1C  333D                      DC    0333D       3=                                1109
0A1D  4449                      DC    04449       DI                                1110
0A1E  5350                      DC    05350       SP                                1111
0A1F  4C41                      DC    04C41       LA                                1112
0A20  5920                      DC    05920       Y                                 1113
```

```
LOC   OBJECT CODE      CARD IMAGE                                                  CARDNUM
0A21  5245                     DC     05245          RE                            1114
0A22  4345                     DC     04345          CE                            1115
0A23  4956                     DC     04956          IV                            1116
0A24  4544                     DC     04544          ED                            1117
0A25  0D0A                     DC     00D0A          CR/LF                         1118
0A26  343D                     DC     0343D          4=                            1119
0A27  454E                     DC     0454E          EN                            1120
0A28  5445                     DC     05445          TE                            1121
0A29  5220                     DC     05220          R                             1122
0A2A  5445                     DC     05445          TE                            1123
0A2B  4E54                     DC     04E54          NT                            1124
0A2C  4154                     DC     04154          AT                            1125
0A2D  4956                     DC     04956          IV                            1126
0A2E  450D                     DC     0450D          E/CR                          1127
0A2F  0A35                     DC     00A35          LF/5                          1128
0A30  3D53                     DC     03D53          =S                            1129
0A31  4341                     DC     04341          CA                            1130
0A32  4E20                     DC     04E20          N                             1131
0A33  0D0A                     DC     00D0A          CR/LF                         1132
0A34  363D                     DC     0363D          6=                            1133
0A35  5245                     DC     05245          RE                            1134
0A36  4345                     DC     04345          CE                            1135
0A37  4956                     DC     04956          IV                            1136
0A38  4520                     DC     04520          E                             1137
0A39  434F                     DC     0434F          CO                            1138
0A3A  4E54                     DC     04E54          NT                            1139
0A3B  524F                     DC     0524F          RO                            1140
0A3C  4C20                     DC     04C20          L                             1141
0A3D  0D0A                     DC     00D0A          CR/LF                         1142
0A3E  373D                     DC     0373D          7=                            1143
0A3F  444F                     DC     0444F          DO                            1144
0A40  4E45                     DC     04E45          NE                            1145
0A41  0D0A                     DC     00D0A          CR/LF                         1146
0A42  383D                     DC     0383D          8=                            1147
0A43  5245                     DC     05245          RE                            1148
0A44  494E                     DC     0494E          IN                            1149
0A45  4954                     DC     04954          IT                            1150
0A46  494C                     DC     0494C          IL                            1151
0A47  495A                     DC     0495A          IZ                            1152
0A48  4520                     DC     04520          E                             1153
0A49  0D0A                     DC     00D0A          CR/LF                         1154
0A4A  0000                     DC     0              NULL                          1155
                                                                                    1156
                       * FREQUENCY TITLE BUFFER                                     1157
0A4B  0006             WJFB    DC     6              COUNT                         1158
0A4C  4652                     DC     04652          FR                            1159
0A4D  4551                     DC     04551          EQ                            1160
0A4E  2028                     DC     02028          (                             1161
0A4F  485A                     DC     0485A          HZ                            1162
0A50  2920                     DC     02920          )                             1163
0A51  0D0A                     DC     00D0A          CR/LF                         1164
0A52  0000                     DC     0              NULL                          1165
                       *                                                            1166
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM

                    . GAIN MODE TITLE BUFFER                                        1167
0A53  0018          WJGMB   DC    24          COUNT                                 1168
0A54  4741                  DC    04741       GA                                    1169
0A55  494E                  DC    0494E       IN                                    1170
0A56  204D                  DC    0204D        M                                    1171
0A57  4F44                  DC    04F44       OD                                    1172
0A58  450D                  DC    0450D       ECR                                   1173
0A59  0A30                  DC    00A30       LF0                                   1174
0A5A  3D48                  DC    03D48       =H                                    1175
0A5B  4F4C                  DC    04F4C       OL                                    1176
0A5C  4420                  DC    04420       D                                     1177
0A5D  4147                  DC    04147       AG                                    1178
0A5E  430D                  DC    0430D       CCR                                   1179
0A5F  0A32                  DC    00A32       LF2                                   1180
0A60  3D4E                  DC    03D4E       =N                                    1181
0A61  4F52                  DC    04F52       OR                                    1182
0A62  4D41                  DC    04D41       MA                                    1183
0A63  4C20                  DC    04C20       L                                     1184
0A64  4147                  DC    04147       AG                                    1185
0A65  430D                  DC    0430D       CCR                                   1186
0A66  0A33                  DC    00A33       LF3                                   1187
0A67  3D4D                  DC    03D4D       =M                                    1188
0A68  414E                  DC    0414E       AN                                    1189
0A69  5541                  DC    05541       UA                                    1190
0A6A  4C20                  DC    04C20       L                                     1191
0A6B  0D0A                  DC    00D0A       CR/LF                                 1192
0A6C  0000                  DC    0           NULL                                  1193
                                                                                    1194
                    . IF BANDWIDTH TITLE BUFFER                                     1195
0A6D  001A          WJIFB   DC    26          COUNT                                 1196
0A6E  4946                  DC    04946       IF                                    1197
0A6F  2042                  DC    02042        B                                    1198
0A70  414E                  DC    0414E       AN                                    1199
0A71  4457                  DC    04457       DW                                    1200
0A72  4944                  DC    04944       ID                                    1201
0A73  5448                  DC    05448       TH                                    1202
0A74  0D0A                  DC    00D0A       CR/LF                                 1203
0A75  313D                  DC    0313D       1=                                    1204
0A76  3530                  DC    03530       50                                    1205
0A77  3020                  DC    03020       0                                     1206
0A78  485A                  DC    0485A       HZ                                    1207
0A79  0D0A                  DC    00D0A       CR/LF                                 1208
0A7A  323D                  DC    0323D       2=                                    1209
0A7B  3220                  DC    03220       2                                     1210
0A7C  4B48                  DC    04B48       KH                                    1211
0A7D  5A0D                  DC    05A0D       ZCR                                   1212
0A7E  0A33                  DC    00A33       LF3                                   1213
0A7F  3D34                  DC    03D34       =4                                    1214
0A80  204B                  DC    0204B        K                                    1215
0A81  485A                  DC    0485A       HZ                                    1216
0A82  0D0A                  DC    00D0A       CR/LF                                 1217
0A83  343D                  DC    0343D       4=                                    1218
0A84  3820                  DC    03820       8                                     1219
```

```
LOC   OBJECT CODE     CARD IMAGE                                                CARDNUM
0A85  4B48                    DC    04B48          KH                             1220
0A86  5A20                    DC    05A20          Z                              1221
0A87  0D0A                    DC    00D0A          CR/LF                          1222
0A88  0000                    DC    0              NULL                           1223
                      .                                                           1224
                      . DEIECT MODE TITLE BUFFER                                  1225
0A89  0028            WJDMB   DC    40             COUNT                          1226
0A8A  4445                    DC    04445          DE                             1227
0A8B  5445                    DC    05445          TE                             1228
0A8C  4354                    DC    04354          CT                             1229
0A8D  204D                    DC    0204D           M                             1230
0A8E  4F44                    DC    04F44          OD                             1231
0A8F  450D                    DC    0450D          ECR                            1232
0A90  0A30                    DC    00A30          LF0                            1233
0A91  3D41                    DC    03D41          =A                             1234
0A92  4D0D                    DC    04D0D          MCR                            1235
0A93  0A31                    DC    00A31          LF1                            1236
0A94  3D46                    DC    03D46          =F                             1237
0A95  4D0D                    DC    04D0D          MCR                            1238
0A96  0A32                    DC    00A32          LF2                            1239
0A97  3D42                    DC    03D42          =B                             1240
0A98  464F                    DC    0464F          FO                             1241
0A99  2046                    DC    02046           F                             1242
0A9A  4958                    DC    04958          IX                             1243
0A9B  4544                    DC    04544          ED                             1244
0A9C  0D0A                    DC    00D0A          CR/LF                          1245
0A9D  333D                    DC    0333D          3=                             1246
0A9E  4246                    DC    04246          BF                             1247
0A9F  4F20                    DC    04F20          O                              1248
0AA0  5641                    DC    05641          VA                             1249
0AA1  520D                    DC    0520D          RCR                            1250
0AA2  0A34                    DC    00A34          LF4                            1251
0AA3  3D49                    DC    03D49          =1                             1252
0AA4  5342                    DC    05342          SB                             1253
0AA5  0D0A                    DC    00D0A          CR/LF                          1254
0AA6  353D                    DC    0353D          5=                             1255
0AA7  4C53                    DC    04C53          LS                             1256
0AA8  420D                    DC    0420D          BCR                            1257
0AA9  0A36                    DC    00A36          LF6                            1258
0AAA  3D55                    DC    03D55          =U                             1259
0AAB  5342                    DC    05342          SB                             1260
0AAC  0D0A                    DC    00D0A          CR/LF                          1261
0AAD  373D                    DC    0373D          7=                             1262
0AAE  414D                    DC    0414D          AM                             1263
0AAF  2D4E                    DC    02D4E          -N                             1264
0AB0  4C20                    DC    04C20          L                              1265
0AB1  0D0A                    DC    00D0A          CR/LF                          1266
0AB2  0000                    DC    0              NULL                           1267
                      .                                                           1268
                      . BFO FREQUENCY TITLE BUFFER                                1269
0AB3  0015            WJBFB   DC    21             COUNT                          1270
0AB4  4246                    DC    04246          BF                             1271
0AB5  4F20                    DC    04F20          O                              1272
```

```
LOC    OBJECT CODE      CARD IMAGE                                                                                      CARDNUM
0AB6   4652                     DC      04652                FR                                                         1273
0AB7   4551                     DC      04551                EQ                                                         1274
0AB8   2028                     DC      02028                 (                                                         1275
0AB9   485A                     DC      0485A                HZ                                                         1276
0ABA   2920                     DC      02920                )                                                          1277
0ABB   0D0A                     DC      00D0A                CR/LF                                                      1278
0ABC   3434                     DC      03434                44                                                         1279
0ABD   3520                     DC      03520                5                                                          1280
0ABE   4B48                     DC      04B48                KH                                                         1281
0ABF   5A20                     DC      05A20                Z                                                          1282
0AC0   544F                     DC      0544F                TO                                                         1283
0AC1   2034                     DC      02034                 4                                                         1284
0AC2   3635                     DC      03635                65                                                         1285
0AC3   204B                     DC      0204B                 K                                                         1286
0AC4   485A                     DC      0485A                HZ                                                         1287
0AC5   2049                     DC      02049                 I                                                         1288
0AC6   4E20                     DC      04E20                N                                                          1289
0AC7   485A                     DC      0485A                HZ                                                         1290
0AC8   0D0A                     DC      00D0A                CR/LF                                                      1291
0AC9   0000                     DC      0                    NULL                                                       1292
                         .                                                                                              1293
                         .RF GAIN TITLE BUFFER                                                                          1294
0ACA   000C              WJRFGB DC      12                   COUNT                                                      1295
0ACB   5246                     DC      05246                RF                                                         1296
0ACC   2047                     DC      02047                 G                                                         1297
0ACD   4149                     DC      04149                AI                                                         1298
0ACE   4E0D                     DC      04E0D                NCR                                                        1299
0ACF   0A28                     DC      00A28                LF(                                                        1300
0AD0   5045                     DC      05045                PE                                                         1301
0AD1   5243                     DC      05243                RC                                                         1302
0AD2   454E                     DC      0454E                EN                                                         1303
0AD3   5441                     DC      05441                TA                                                         1304
0AD4   4745                     DC      04745                GE                                                         1305
0AD5   2920                     DC      02920                )                                                          1306
0AD6   0D0A                     DC      00D0A                CR/LF                                                      1307
0AD7   0000                     DC      0                    NULL                                                       1308
                         .                                                                                              1309
                         . FREQUENCY TITLE FOR DISPLAY                                                                  1310
0AD8   000B              WJDF   DC      11                   COUNT                                                      1311
0AD9   4652                     DC      04652                FR                                                         1312
0ADA   4551                     DC      04551                EQ                                                         1313
0ADB   203D                     DC      0203D                 =                                                         1314
0ADC   2020                     DC      02020                                                                           1315
0ADD   2020              WJDF1  DC      02020                XX                                                         1316
0ADE   2020                     DC      02020                XX                                                         1317
0ADF   2020                     DC      02020                XX                                                         1318
0AE0   2020                     DC      02020                XX                                                         1319
0AE1   2048                     DC      02048                 H                                                         1320
0AE2   5A20                     DC      05A20                Z                                                          1321
0AE3   0D0A                     DC      00D0A                CR/LF                                                      1322
0AE4   0000                     DC      0                    NULL                                                       1323
                         .                                                                                              1324
                         . DETECT MODE TITLE FOR DISPLAY                                                                1325
```

```
LOC   OBJECT CODE     CARD IMAGE                                    CARDNUM
0AE5  0007          WJDDM   DC    7                 COUNT             1326
0AE6  4445                  DC    04445             DE                1327
0AE7  5445                  DC    05445             TE                1328
0AE8  4354                  DC    04354             CT                1329
0AE9  204D                  DC    0204D              M                1330
0AEA  4F44                  DC    04F44             OD                1331
0AEB  4520                  DC    04520             E                 1332
0AEC  3D20                  DC    03D20             =                 1333
0AED  0000                  DC    0                 NULL              1334
                    .                                                 1335
                    . BFO FREQUENCY TITLE FOR DISPLAY                 1336
0AEE  000B          WJDBF   DC    11                COUNT             1337
0AEF  4246                  DC    04246             BF                1338
0AF0  4F20                  DC    04F20             O                 1339
0AF1  4652                  DC    04652             FR                1340
0AF2  4551                  DC    04551             EQ                1341
0AF3  203D                  DC    0203D              =                1342
0AF4  2034                  DC    02034              4                1343
0AF5  2020          WJDBF1  DC    02020             XX                1344
0AF6  2020                  DC    02020             XX                1345
0AF7  3020                  DC    03020             0                 1346
0AF8  485A                  DC    0485A             HZ                1347
0AF9  0D0A                  DC    0D0A              CR/LF             1348
0AFA  0000                  DC    0                 NULL              1349
                    .                                                 1350
                    . GAIN MODE TITLE FOR DISPLAY                     1351
0AFB  0006          WJDGM   DC    6                 COUNT             1352
0AFC  4741                  DC    04741             GA                1353
0AFD  494E                  DC    0494E             IN                1354
0AFE  204D                  DC    0204D              M                1355
0AFF  4F44                  DC    04F44             OD                1356
0B00  4520                  DC    04520             E                 1357
0B01  3D20                  DC    03D20             =                 1358
0B02  0000                  DC    0                 NULL              1359
                    .                                                 1360
                    . IF BANDWIDTH TITLE FOR DISPLAY                  1361
0B03  0008          WJDIF   DC    8                 COUNT             1362
0B04  4946                  DC    04946             IF                1363
0B05  2042                  DC    02042              B                1364
0B06  414E                  DC    0414E             AN                1365
0B07  4457                  DC    04457             DW                1366
0B08  4944                  DC    04944             ID                1367
0B09  5448                  DC    05448             TH                1368
0B0A  203D                  DC    0203D              =                1369
0B0B  2020                  DC    02020                               1370
0B0C  0000                  DC    0                 NULL              1371
                    .                                                 1372
                    . RF GAIN TITLE FOR DISPLAY                       1373
0B0D  0009          WJDRF   DC    9                 COUNT             1374
0B0E  5246                  DC    05246             RF                1375
0B0F  2047                  DC    02047              G                1376
0B10  4149                  DC    04149             AI                1377
0B11  4E20                  DC    04E20             N                 1378
```

```
IOC   OBJECT CODE      CARD IMAGE                                                CARDNUM

0B12  3D20                     DC     03D20              =                          1379
0B13  2020             WJDRF1  DC     02020              XX                         1380
0B14  2020                     DC     02020              XX                         1381
0B15  2520                     DC     02520              %                          1382
0B16  0D0A                     DC     00D0A              CR/LF                      1383
0B17  0000                     DC     0                  NULL                       1384
                       .                                                           1385
                       . SIGNAL STRENGTH TITLE FOR DISPLAY                         1386
0E18  000D             WJDSS   DC     13                 COUNT                      1387
0B19  5349                     DC     05349              SI                         1388
0E1A  474E                     DC     04742              GN                         1389
0B1B  414C                     DC     0414C              AL                         1390
0B1C  2053                     DC     02053               S                         1391
0B1D  5452                     DC     05452              TR                         1392
0B1E  454E                     DC     0454E              EN                         1393
0B1F  4754                     DC     04754              GT                         1394
0B20  4820                     DC     04820              H                          1395
0B21  3D20                     DC     03D20              =                          1396
0B22  2020             WJDSS1  DC     02020              XX                         1397
0B23  2020                     DC     02020              XX                         1398
0B24  2520                     DC     02520              %                          1399
0B25  0D0A                     DC     0D0A               CR/LF                      1400
0B26  0000                     DC     0                  NULL                       1401
                       .                                                           1402
                       . TABLE OF GAIN MODES FOR DISPLAY                           1403
0B27  0B2B             WJGMTB  DC     WJGM0              HOLD AGC                   1404
0B28  0B32                     DC     WJGM1              NOT USED                   1405
0B29  0B34                     DC     WJGM2              NORMAL AGC                 1406
0B2A  0B3C                     DC     WJGM3              MANUAL                     1407
                       .                                                           1408
                       .                                                           1409
0B2B  0005             WJGM0   DC     5                  COUNT/HOLD AGC             1410
0B2C  484F                     DC     0484F              HO                         1411
0B2D  4C44                     DC     04C44              LD                         1412
0B2E  2041                     DC     02041               A                         1413
0B2F  4743                     DC     04743              GC                         1414
0B30  0D0A                     DC     00D0A              CR/LF                      1415
0B31  0000                     DC     0                  NULL                       1416
                       .                                                           1417
                       .                                                           1418
0B32  FFFF             WJGM1   DC     -1                 COUNT/INVALID ENTRY        1419
0B33  0000                     DC     0                  NULL                       1420
                       .                                                           1421
                       .                                                           1422
0B34  0006             WJGM2   DC     6                  COUNT/NORMAL AGC           1423
0B35  4E4F                     DC     04E4F              NO                         1424
0B36  524D                     DC     0524D              RM                         1425
0B37  414C                     DC     0414C              AL                         1426
0B38  2041                     DC     02041               A                         1427
0B39  4743                     DC     04743              GC                         1428
0B3A  0D0A                     DC     00D0A              CR/LF                      1429
0B3B  0000                     DC     0                  NULL                       1430
                       .                                                           1431
```

```
LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
                                                                                      1432
0B3C  0004            WJGM3   DC    4                 COUNT/MANUAL                  1433
0B3D  4D41                    DC    04D41             MA                            1434
0B3E  4E55                    DC    04E55             NU                            1435
0B3F  414C                    DC    0414C             AL                            1436
0B40  0D0A                    DC    00D0A             CR/LF                         1437
0B41  0000                    DC    0                 NULL                          1438
                              .                                                       1439
                              . TABLE OF IF BANDWIDTHS FOR DISPLAY                    1440
0B42  0B47            WJIFTB  DC    WJIF0             NOT USED                      1441
0B43  0B49                    DC    WJIF1             500HZ                         1442
0B44  0B4F                    DC    WJIF2             2KHZ                          1443
0B45  0B55                    DC    WJIF3             4KHZ                          1444
0B46  0B5B                    DC    WJIF4             8KHZ                          1445
                              .                                                       1446
                              .                                                       1447
0B47  FFFF            WJIF0   DC    -1                COUNT/INVALID ENTRY           1448
0B48  0000                    DC    0                 NULL                          1449
                              .                                                       1450
                              .                                                       1451
0B49  0004            WJIF1   DC    4                 COUNT/500KHZ                  1452
0B4A  3530                    DC    03530             50                            1453
0B4B  3020                    DC    03020             0                             1454
0B4C  485A                    DC    0485A             HZ                            1455
0B4D  0D0A                    DC    00D0A             CR/LF                         1456
0B4E  0000                    DC    0                 NULL                          1457
                              .                                                       1458
                              .                                                       1459
0B4F  0004            WJIF2   DC    4                 COUNT/2KHZ                    1460
0B50  3220                    DC    03220             2                             1461
0B51  4B48                    DC    04B48             KH                            1462
0B52  5A20                    DC    05A20             Z                             1463
0B53  0D0A                    DC    00D0A             CR/LD                         1464
0B54  0000                    DC    0                 NULL                          1465
                              .                                                       1466
                              .                                                       1467
0B55  0004            WJIF3   DC    4                 COUNT/4KHZ                    1468
0B56  3420                    DC    03420             4                             1469
0B57  4B48                    DC    04B48             KH                            1470
0B58  5A20                    DC    05A20             Z                             1471
0B59  0D0A                    DC    00D0A             CR/LF                         1472
0B5A  0000                    DC    0                 NULL                          1473
                              .                                                       1474
                              .                                                       1475
0B5B  0004            WJIF4   DC    4                 COUNT/8 KHZ                   1476
0B5C  3820                    DC    03820             8                             1477
0B5D  4B48                    DC    04B48             KH                            1478
0B5E  5A20                    DC    05A20             Z                             1479
0B5F  0D0A                    DC    00D0A             CR/LF                         1480
0B60  0000                    DC    0                 NULL                          1481
                              .                                                       1482
                              . TABLE OF DETECT MODES FOR DISPLAY                     1483
0B61  0B69            WJDMTB  DC    WJDM1             AM                            1484
```

```
LOC   OBJECT CODE      CARD IMAGE                                                    CARDNUM
0E62  0B6D                    DC    WJDM2     FM                                      1485
0B63  0B71                    DC    WJDM3     BFO FIXED                               1486
0B64  0B79                    DC    WJDM4     BFO VARIABLE                            1487
0B65  0B82                    DC    WJDM5     ISB                                     1488
0B66  0B87                    DC    WJDM6     LSB                                     1489
0E67  0B8C                    DC    WJDM7     USB                                     1490
0B68  0B91                    DC    WJDM8     AM-NL                                   1491
                        .                                                             1492
                        .                                                             1493
0B69  0002            WJDM1   DC    2         COUNT/AM                                1494
0B6A  414D                    DC    0414D     AM                                      1495
0B6B  0D0A                    DC    00D0A     CR/LF                                   1496
0B6C  0000                    DC    0         NULL                                    1497
                        .                                                             1498
                        .                                                             1499
0B6D  0002            WJDM2   DC    2         COUNT/FM                                1500
0B6E  464D                    DC    0464D     FM                                      1501
0B6F  0D0A                    DC    00D0A     CR/LF                                   1502
0B70  0000                    DC    0         NULL                                    1503
                        .                                                             1504
                        .                                                             1505
0B71  0006            WJDM3   DC    6         COUNT/BFO FIXED                         1506
0B72  4246                    DC    04246     BF                                      1507
0B73  4F20                    DC    04F20     O                                       1508
0B74  4649                    DC    04649     FI                                      1509
0B75  5845                    DC    05845     XE                                      1510
0B76  4420                    DC    04420     D                                       1511
0B77  0D0A                    DC    00D0A     CR/LF                                   1512
0B78  0000                    DC    0         NULL                                    1513
                        .                                                             1514
                        .                                                             1515
0B79  0007            WJDM4   DC    7         COUNT/BFO VARIABLE                      1516
0B7A  4246                    DC    04246     BF                                      1517
0B7B  4F20                    DC    04F20     O                                       1518
0B7C  5641                    DC    05641     VA                                      1519
0B7D  5249                    DC    05249     RI                                      1520
0B7E  4142                    DC    04142     AB                                      1521
0B7F  4C45                    DC    04C45     LE                                      1522
0B80  0D0A                    DC    00D0A     CR/LF                                   1523
0B81  0000                    DC    0         NULL                                    1524
                        .                                                             1525
                        .                                                             1526
0B82  0003            WJDM5   DC    3         COUNT/ISB                               1527
0B83  4953                    DC    04953     IS                                      1528
0B84  4220                    DC    04220     B                                       1529
0B85  0D0A                    DC    00D0A     CR/LF                                   1530
0B86  0000                    DC    0         NULL                                    1531
                        .                                                             1532
                        .                                                             1533
0B87  0003            WJDM6   DC    3         COUNT/LSB                               1534
0B88  4C53                    DC    04C53     LS                                      1535
0B89  4220                    DC    04220     B                                       1536
0B8A  0D0A                    DC    00D0A     CR/LF                                   1537
```

```
LOC   OBJECT CODE     CARD IMAGE                                                  CARDNUM
0B8B  0000                  DC    0              NULL                               1538
                            .                                                      1539
                            .                                                      1540
0B8C  0003            WJDM7 DC    3              COUNT/USB                          1541
0B8D  5553                  DC    05553          US                                 1542
0B8E  4220                  DC    04220          B                                  1543
0B8F  0D0A                  DC    00D0A          CR/LF                              1544
0B90  0000                  DC    0              NULL                               1545
                            .                                                      1546
                            .                                                      1547
0B91  0004            WJDM8 DC    4              COUNT/AM-NL                        1548
0B92  414D                  DC    0414D          AM                                 1549
0B93  2D4E                  DC    02D4E          -N                                 1550
0B94  4C20                  DC    04C20          L                                  1551
0B95  0D0A                  DC    00D0A          CR/LF                              1552
0B96  0000                  DC    0              NULL                               1553
                            .                                                      1554
                            . SCAN TITLE                                           1555
0B97  0003            WJSCAN DC   3              COUNT                              1556
0B98  5343                  DC    05343          SC                                 1557
0B99  414E                  DC    0414E          AN                                 1558
0B9A  0D0A                  DC    00D0A          CR/LF                              1559
0B9B  0000                  DC    0              NULL                               1560
                            .                                                      1561
                            . START FREQUENCY TITLE                                1562
0B9C  0009            WJSFS DC    9              COUNT                              1563
0B9D  5354                  DC    05354          ST                                 1564
0B9E  4152                  DC    04152          AR                                 1565
0B9F  5420                  DC    05420          T                                  1566
0BA0  4652                  DC    04652          FR                                 1567
0BA1  4551                  DC    04551          EQ                                 1568
0BA2  2049                  DC    02049           I                                 1569
0BA3  4E20                  DC    04E20          N                                  1570
0BA4  485A                  DC    0485A          HZ                                 1571
0BA5  0D0A                  DC    00D0A          CR/LF                              1572
0BA6  0000                  DC    0              NULL                               1573
                            .                                                      1574
                            . END FREQUENCY TITLE                                  1575
0BA7  0008            WJSFE DC    8              COUNT                              1576
0BA8  454E                  DC    0454E          EN                                 1577
0BA9  4420                  DC    04420          D                                  1578
0BAA  4652                  DC    04652          FR                                 1579
0BAB  4551                  DC    04551          EQ                                 1580
0BAC  2049                  DC    02049           I                                 1581
0BAD  4E20                  DC    04E20          N                                  1582
0BAE  485A                  DC    0485A          HZ                                 1583
0BAF  0D0A                  DC    00D0A          CR/LF                              1584
0BB0  0000                  DC    0              NULL                               1585
                            .                                                      1586
                            . FREQUENCY INCREMENT TITLE                            1587
0BB1  000B            WJSFI DC    11             COUNT                              1588
0BB2  4652                  DC    04652          FR                                 1589
0BB3  4551                  DC    04551          EQ                                 1590
```

```
LOC   OBJECT CODE     CARD IMAGE                                                CARDNUM
0BB4  2049                    DC    02049          I                              1591
0BB5  4E43                    DC    04E43          NC                             1592
0BB6  5245                    DC    05245          RE                             1593
0BB7  4D45                    DC    04D45          ME                             1594
0BB8  4E54                    DC    04E54          NT                             1595
0BB9  2049                    DC    02049          I                              1596
0BBA  4E20                    DC    04E20          N                              1597
0BBB  485A                    DC    0485A          HZ                             1598
0BBC  0D0A                    DC    00D0A          CR/LF                          1599
0BBD  0000                    DC    0              NULL                           1600
                                                                                   1601
                      . SIGNAL STRENGTH TITLE                                      1602
0BBE  000A            WJSSS   DC    10             COUNT                          1603
0BBF  5349                    DC    05349          SI                             1604
0BC0  474E                    DC    0474E          GN                             1605
0BC1  414C                    DC    0414C          AL                             1606
0BC2  2053                    DC    02053           S                             1607
0BC3  5452                    DC    05452          TR                             1608
0BC4  454E                    DC    0454E          EN                             1609
0BC5  4754                    DC    04754          GT                             1610
0BC6  4820                    DC    04820          H                              1611
0BC7  2520                    DC    02520          %                              1612
0BC8  0D0A                    DC    00D0A          CR/LF                          1613
0BC9  0000                    DC    0              NULL                           1614
                                                                                   1615
                      . NO FIND MESSAGE FOR SCAN                                   1616
0BCA  0006            WJSNF   DC    6              COUNT                          1617
0BCB  4E4F                    DC    04E4F          NO                             1618
0BCC  2053                    DC    02053           S                             1619
0BCD  4947                    DC    04947          IG                             1620
0BCE  4E41                    DC    04E41          NA                             1621
0BCF  4C20                    DC    04C20          L                              1622
0BD0  0D0A                    DC    00D0A          CR/LF                          1623
0BD1  0000                    DC    0              NULL                           1624
                      .                                                            1625
                      .                                                            1626
                      . LOOP MESSAGE                                               1627
0ED2  001D            WJCF    DC    29             COUNT                          1628
0BD3  0707                    DC    00707          BELL BELL                      1629
0ED4  494E                    DC    0494E          IN                             1630
0BD5  4649                    DC    04649          FI                             1631
0BD6  4E49                    DC    04E49          NI                             1632
0BD7  5445                    DC    05445          TE                             1633
0BD8  204C                    DC    0204C           L                             1634
0BD9  4F4F                    DC    04F4F          OO                             1635
0EDA  500D                    DC    0500D          PCR                            1636
0BDB  0A5D                    DC    00A5D          LFP                            1637
0BDC  4C45                    DC    04C45          LE                             1638
0BDD  4153                    DC    04153          AS                             1639
0BDE  4520                    DC    04520          E                              1640
0BDF  4348                    DC    04348          CH                             1641
0BE0  4543                    DC    04543          EC                             1642
0BE1  4B20                    DC    04B20          K                              1643
```

```
LOC   OBJECT CODE     CARD IMAGE                                                CARDNUM
0EE2  494E                 DC    0494E     IN                                    1644
0BE3  5445                 DC    05445     TE                                    1645
0BE4  5246                 DC    05246     RF                                    1646
0BE5  4143                 DC    04143     AC                                    1647
0BE6  4520                 DC    04520     E                                     1648
0EE7  414E                 DC    0414E     AN                                    1649
0BE8  4420                 DC    04420     D                                     1650
0BE9  5245                 DC    05245     RE                                    1651
0BEA  4345                 DC    04345     CE                                    1652
0BEB  4956                 DC    04956     IV                                    1653
0BEC  4552                 DC    04552     ER                                    1654
0BED  C707                 DC    00707     BELL BELL                             1655
0BEE  0D0A                 DC    00D0A     CR/LF                                 1656
0BEF  0000                 DC    0000      NULL                                  1657
                                                                                 1658
                           PAGE                                                  1659
```

BIBLIOGRAPHY

1. Applied Technology Airborne Computer, v. 1, Principles of Operation, Itek Corp., 1974.

2. Applied Technology Airborne Computer, v. 7, Input/Output Description, Itek Corp., 1974.

3. Applied Technology Airborne Computer, v. 8, Assembler/Loader, Itek Corp., 1974.

4. Instruction Manual for AJ-8888 HF Receiver, Watkins Johnson Co., 1975.

5. Rosenberger, D. K., Signal Acquisition and Sampling using a Microprocessor, M.S. Thesis, United States Naval Postgraduate School, 1977.

INITIAL DISTRIBUTION LIST

		No. Copies
1.	Defense Documentation Center Cameron Station Alexandria, Virginia 22314	2
2.	Library, Code 0212 Naval Postgraduate School Monterey, California 93940	2
3.	Professor D. E. Kirk, Code 62Ki Department Chairman Department of Electrical Engineering Naval Postgraduate School Monterey, California 93940	1
4.	Associate Professor Stephen Jauregui, Jr. Code 62Ja Department of Electrical Engineering Naval Postgraduate School Monterey, California 93940	10
5.	LT. William Glenn Borries, USN 2593 Lipton Road Columbus, Ohio 43227	1
6.	Watkins Johnson Company 700 Quince Orchard Road Gaithesburg, Maryland 20760 ATTN: Roy Scherer	1
7.	Applied Technology 645 Alamanor Avenue Sunnyvale, California 94086 ATTN: Ira Spector	1

8. Commander Naval Electronics Systems Command 3
PME-107
Washington, D.C. 20360
ATTN: Mr. R. LeSage
Capt. W. Flowers
Mr. P. Lowell

9. Commander Naval Security Group Command 1
G-82
3801 Nebraska Avenue
Washington, D.C. 20390
ATTN: CDR. Shoemaker

10. Watkins Johnson Company 1
3333 Hillview Avenue
Palo Alto, California 94304
ATTN: Mr. T. Harper